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Upgrade of Tropical Cyclone Surface Wind Field Model

by Vincent J. Cardone, Andrew T. Cox, J. Arthur Greenwood, Oceanweather, Inc.
Edward F. Thompson, WES

WES

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Prepared for Headquarters, U.S. Army Corps of Engineers

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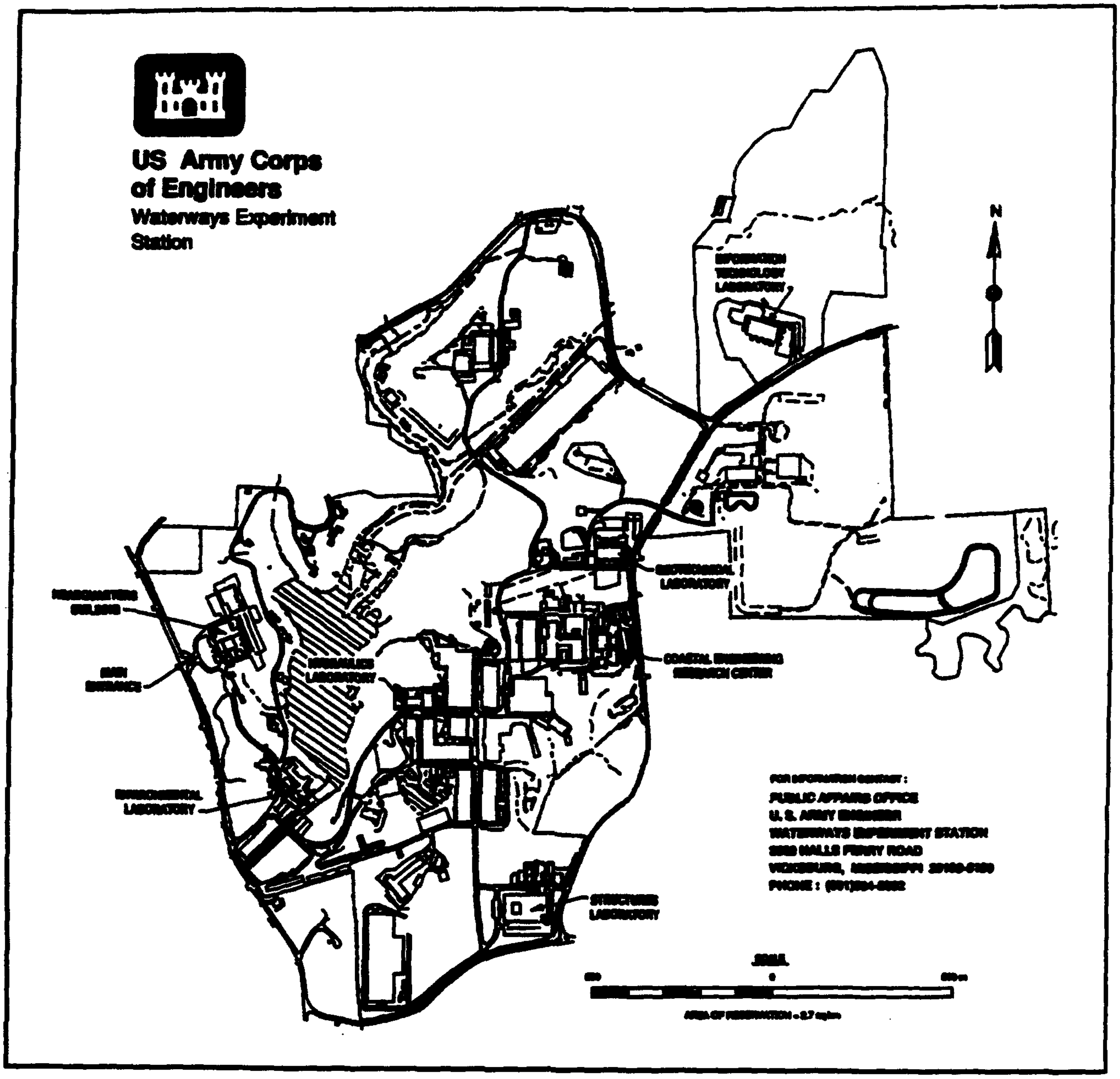

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Preface

This report describes improvements developed for the planetary boundary layer surface wind field model traditionally used by the U.S. Army Corps of Engineers for hurricane modeling. Limitations of the model are also described. The upgraded model has increased flexibility for spatial resolution and pressure profile specification. The wind fields can be used in ocean response modeling, including wave and surge modeling activities.

This study was authorized by Headquarters, U.S. Army Corps of Engineers, under the Coastal Flooding and Storm Protection Area of the Coastal Research Program, Work Unit 32683, "Wind Estimation for Coastal Modeling." Technical Monitors were Messrs. John H. Lockhart, Jr.; John G. Housley; Barry W. Holliday; and John Saucier. Ms. Carolyn M. Holmes of the U.S. Army Engineer Waterways Experiment Station (WES), Coastal Engineering Research Center (CERC), was the Program Manager.

The study was conducted under Contract No. DACW39-93-C-0022 by Oceanweather, Inc. (OWI), Cos Cob, Connecticut. The report was prepared by Dr. Vincent J. Cardone and Messrs. Andrew T. Cox and J. Arthur Greenwood, all of OWI, and Dr. Edward F. Thompson of the Coastal Oceanography Branch (COB), Research Division (RD), CERC. Dr. Thompson was Principal Investigator of the research work unit funding this study. The work unit was under the direct supervision of Dr. Martin C. Miller, Chief, COB, and Mr. H. Lee Butler, Chief, RD, and under the general supervision of Mr. Charles C. Calhoun, Jr., Assistant Director, CERC, and Dr. James R. Houston, Director, CERC.

At the time of publication of this report, Director of WES was Dr. Robert W. Whalin. Commander was COL Bruce K. Howard, EN.

Conversion Factors, Non-SI to SI Units of Measurement

Non-SI units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
degrees (angle)	0.01745329	radians
knots (international)	0.5144444	meters per second
miles (U.S. nautical)	1.852	kilometers

1 Introduction

Background

The unprecedented destruction of parts of the United States caused by hurricanes Andrew and Iniki last summer has aroused increased interest in the wind structure of tropical cyclones among the scientific and engineering communities. Unlike most past destructive storms, much of the loss in these recent storms was associated with direct wind damage. While simple parametric tropical cyclone wind models remain in use to model surface winds and to provide forcing for ocean response models, a few numerical vortex boundary layer models based upon solution of the primitive equations of motion have emerged, including most prominently the so-called U.S. Army Corps of Engineers (CE) wind model (Cardone et al. 1992). The model was developed originally at New York University in the early 1970's and later further developed at Oceanweather Inc. (OWI) under CE support in 1979. Recently the format of the CE model was modified to conform with the requirements of the CE Coastal Modeling System (Thompson 1993).

The CE numerical model was reviewed as part of a Workshop on Tropical Wind Modeling convened at the U.S. Army Engineer Waterways Experiment Station on 24-25 March, 1992. Invited participants in the review were:

- Dr. Wilson A. Schaffer, Techniques Development Laboratory, National Weather Service (NWS), National Oceanic and Atmospheric Administration (NOAA)
- Dr. Mark D. Powell, Hurricane Research Division (HRD), Atlantic Oceanographic and Meteorological Laboratory, Environmental Research Laboratories, NOAA
- Dr. Mukut B. Mathur, National Meteorological Center, NWS, NOAA
- Dr. Vincent J. Cardone, OWI

The workshop stressed the relationship between surface wind modeling and more general questions of the dynamical and thermodynamic nature of tropical cyclones. It also emphasized the need to carefully evaluate the reliability and representativeness of the scant surface marine wind data available in intense cyclones, before such data are used to further develop and validate numerical models.

The workshop addressed the potential for further development of existing numerical models, particularly the CE model. A number of specific research needs for improving wind models were identified and prioritized in terms of both importance to ocean response modeling and feasibility of success. These needs are summarized more fully in a "white paper" (Cardone and Thompson 1992).

Subsequent to the workshop, a study was initiated to address high priority upgrades to the CE model which could be accomplished with the limited funds available. The following tasks were chosen: (1) increase resolution and domain of the nested grid system; (2) generalize the surface pressure specification. The enhancements developed for the CE wind model are the subject of this report. The enhancements will be incorporated into the Coastal Modeling System in the near future.

Previous Studies

The CE wind model has been used mainly to provide wind fields in historical tropical cyclones to drive ocean response models operated in a hindcast mode (surface waves, mixed layer currents, storm surge). Those wind fields generally provide unbiased ocean predictions when used to drive CE and OWI ocean response models (e.g Reece and Cardone 1982). They have also been used to drive ocean response models developed by other scientists independently, wherein CE model winds have also repeatedly been shown to provide unbiased hindcasts (e.g. Forristall 1980, WAMDI Group 1988, Cooper and Thompson 1989, Ly and O'Connor 1991, Grosskopf et al. 1991, Mairs et al. 1992). At OWI the model has been used in over three dozen studies to drive ocean response models to establish offshore design criteria in many parts of the world affected by tropical cyclones.

The CE model has been extensively used for both ocean wave and storm surge modeling for CE applications. Abel et al. (1989) applied the model to estimate wave statistics due to hurricanes in the Atlantic Ocean and Gulf of Mexico during 1956-75. Tracy and Hubertz (1990) estimated waves produced by 10 hurricanes impacting southern California during 1956-89. Mark and Scheffner (1993) describe a hurricane surge study for the coast of Delaware. A similar approach is presently being applied to the entire U.S. Atlantic Coast.

The generality of the CE model was also demonstrated when it was used to provide winds to test the third generation wave model (3GWAM) (WAMDI Group 1988). Winds supplied to the WAM model were exactly the same as winds for the subject storms (three intense Gulf of Mexico hurricanes) which had been used in previous studies to drive first and second generation models, and which had been used by other investigators. The WAM model was found to provide unbiased and skillful wave hindcasts in these storms, with WAM using its own calibration of source terms developed completely independently of CE winds. The same tuning on WAM has also been shown to provide

nearly perfect hindcasts in severe extratropical storms as well when driven by extremely accurate wind fields derived by direct kinematic analysis of wind measurements (Cardone et al. 1994).

Scope

In many of the studies cited above, ocean response models were used to evaluate the most extreme response (storm peak winds, waves, surge and currents) in a storm at a fixed site. In general, in storms in which the assumed storm pressure profile fits the actual radial distribution well, modeled storm peaks are unbiased in the mean and exhibit scatter index of 15 percent or less. The method is less successful in modeling the entire spatial and temporal distribution of the wind field in such storms. There are some storms in which even the storm peaks are difficult to simulate, where the storm structure departs from the simple structure implied by the presumed pressure distribution. This and other limitations of the CE model are described in more detail in Chapter 2.

In this study, two limitations of the CE tropical storm wind model are addressed and remedied. The first change is simply the addition of two additional nests to the grid system used to implement the numerical vortex model. This change provides lower truncation errors near the center of small intense storms, greater resolution near the vortex center, and an expanded solution domain. The second change is generalization of the radial surface pressure profile upon which the surface pressure initialization of the vortex model is based. The form adopted also allows the specification of profiles with two maxima in the radial pressure gradient. These changes are described in Chapter 3. A summary is given in Chapter 4.

2 Existing Model Limitations

The CE wind model developed by Cardone et al. (1992) has proved to be a powerful tool in ocean response modeling. However, the model, developed in 1979, includes a number of limitations. In light of enhanced computing power now available and the increasing field measurements and understanding of tropical storm behavior, it is timely to review the model limitations. Limitations of the CE model may be described in three basic categories: physics, initialization, and numerics.

Physics

The CE model evolved from the model of Chow (1971) who solved the momentum equations of an integrated boundary layer flow for a boundary layer of constant depth. The vertical friction force was taken parallel to the wind relative to the earth. Horizontal friction was also considered. The equations, however, were solved numerically on a nested cartesian grid system centered on the vortex and translating at constant velocity with the vortex. The steady solution in the moving coordinate system referred back to the earth yielded qualitatively realistic boundary layer wind patterns. The solution included supergradient flows inside the radius of maximum gradient wind and a decrease in the radius of maximum wind. It also included an asymmetric wind distribution with maxima in the right front quadrant for a typical superposition of a symmetric vortex and ambient gradient, and a boundary layer convergence pattern consistent with observed patterns of convection in typical storms.

Shapiro (1983) solved the same slab momentum equation as Chow (1971) but used a truncated spectral analysis in cylindrical coordinates, in order to allow a more convenient separation of the role of linear and non-linear asymmetric effects in the boundary layer flow. Chow's model and solution method provide the same patterns as that of Shapiro's model except that inside the radius of maximum wind truncation errors are larger than for the spectral solution. As a consequence, Chow's model may slightly overestimate the degree of supergradient flow inside the eye. These studies show that the essential physics governing the boundary layer flow are included in Chow's and Shapiro's models. The main physical processes missing are the feedback of

the convection (induced in part by the modelled convergence field) on the wind field, and strong non-steady effects (for example rapid deepening of the vortex in the moving frame) which may cause even the overlying vortex to be unbalanced.

The CE model is derived directly from Chow's formulation and uses Chow's numerical solution. Several improvements to Chow's solution were made to insure that it not only gives qualitatively realistic wind fields, but also provides a quantitatively correct surface stress vector distribution, from which the model diagnoses winds within the surface boundary layer as well. The main enhancements to Chow's model are in the inclusion of a similarity boundary layer formulation relating vertically integrated flow to the surface drag (magnitude and direction), adoption of more realistic boundary layer depths than considered by Chow or Shapiro, consideration of the effects of boundary layer stratification and variable surface roughness (expressed in terms of wind alone with no sea state effects considered), and incorporation of greater flexibility in the specification of the imposed pressure distribution of the vortex over the possibilities considered by Chow.

The CE model was developed with a secondary objective to provide winds over inland lake surfaces and land surfaces of arbitrary roughness. The theoretical development of this part of the model met with less success than the over-water treatment. A simplified equilibrium boundary layer approach was adopted which ignores the adjustment of the planetary boundary layer (PBL) wind field across discontinuities of roughness. Thus, while the model validation against winds measured over land indicated good agreement when the wind fetch was over a homogeneous roughness, little is known about the effect on ocean response modeling associated with failure in the CE model (probably) to resolve small scale PBL wind changes downwind of abrupt changes in roughness (e.g. the coast).

Initialization

The model is generally applied with boundary layer height in the range of 500 m - 650 m, slightly unstable stratification, a Charnock type surface roughness formulation (Charnock constant 0.035 with Karman constant 0.35), and a value of unity for the Ekman scale height parameter. This combination produces unbiased surface winds over the open sea when the model is applied to real storms and validated against measured surface wind time histories obtained by calibrated instruments (e.g. NOAA buoys, offshore rigs).

The pressure field is generally described as the superposition of the pressure gradient computed from the exponential pressure profile form for the symmetric part of the vortex:

$$p(r) = p_o + (p_\infty - p_o)\, e^{-\frac{R_p}{r}} \tag{1}$$

where

$p(r)$ = pressure

p_o = central pressure (at the eye)

p_∞ = axisymmetric ambient pressure (far field pressure)

R_p = scaling radius

r = radius

and an uniform ambient gradient given by

$$f\,\bar{k} \times \bar{V_g} = -\frac{1}{\rho} \nabla p_a \tag{2}$$

where

f = Coriolis parameter

$\bar{k}$ = unit vector in the vertical direction

$\bar{V_g}$ = ambient uniform geostrophic flow

ρ = mean air density

∇p_a = uniform ambient pressure gradient

This pressure initialization scheme (it is also a boundary condition since the model is solved to a steady state solution) often provides a very realistic simulation of the actual pressure field about a tropical cyclone. However, in some storms the actual pressure field departs from this simple picture in several possible ways. Often, particularly as a tropical cyclone enters the mid-latitudes, the ambient pressure field is inhomogeneous. The effect is especially evident if the tropical cyclone begins to interact with a frontal system or an extratropical cyclone or both. Within the tropics, some storms have been shown (Holland 1980) to follow the more general form:

$$p(r) = p_o + (p_\infty - p_o)\, e^{-\left(\frac{R_r}{r}\right)^B} \tag{3}$$

where

B = constant in the general range $0.5\text{-}2.5$

Finally, in some storms the radial pressure profile in the inner core is more irregular than either of the above forms, with a shape which implies two maxima in the radial pressure gradient, accompanied by two distinct maxima in the wind speed. Willoughby (1990) and Black and Willoughby (1992) have described the tendency for "concentric rings" in the radial wind distribution to be a fairly typical characteristic of intense tropical cyclones. The rings appear to be related intimately to storm intensity evolution. For example, Figure 1 shows the evolution of concentric rings in Hurricane Gilbert (1988) over a six-day period. In this storm, the CE model might be expected to provide reasonably accurate wind fields in the initial stage of vortex development and intensification between September 11-13, but it would fail to model the complicated double maxima structures later. The impact on ocean response modeling of this failure to model concentric rings is unknown.

Numerics

The CE model is computationally demanding. For example, computational considerations drove the decision to presolve the boundary layer model for spatially homogeneous (constant) boundary layer height and stability and to use a table look-up procedure for the drag coefficient during the marching of the solution toward steady state. To relax the constraint of constant boundary layer height and stability would greatly increase computer time, unless a more efficient integration scheme could be found. The minimum grid spacing on the inner nest of the solution grid (as opposed to the target grid) is 5 km, which is a bit too large to resolve details of the wind field near the center in very tight storms. (For example, as Hurricane Andrew approached the south Florida coast, the radius of maximum wind was only about 11 km.) The grid spacing is also not sufficient to resolve boundary layer adjustments near roughness discontinuities, though that physical process is not presently incorporated in the numerical model. Further, the grid spacing is too coarse to resolve detailed gradients of wind over inland bays and estuaries. Limitations in temporal resolution are less serious, within the constraint of the steady-state model, since the "time step" of the windfields is simply the temporal resolution of the storm track. That temporal resolution can be refined within reason (say to intervals of 15 minutes or so) without significant computational cost.

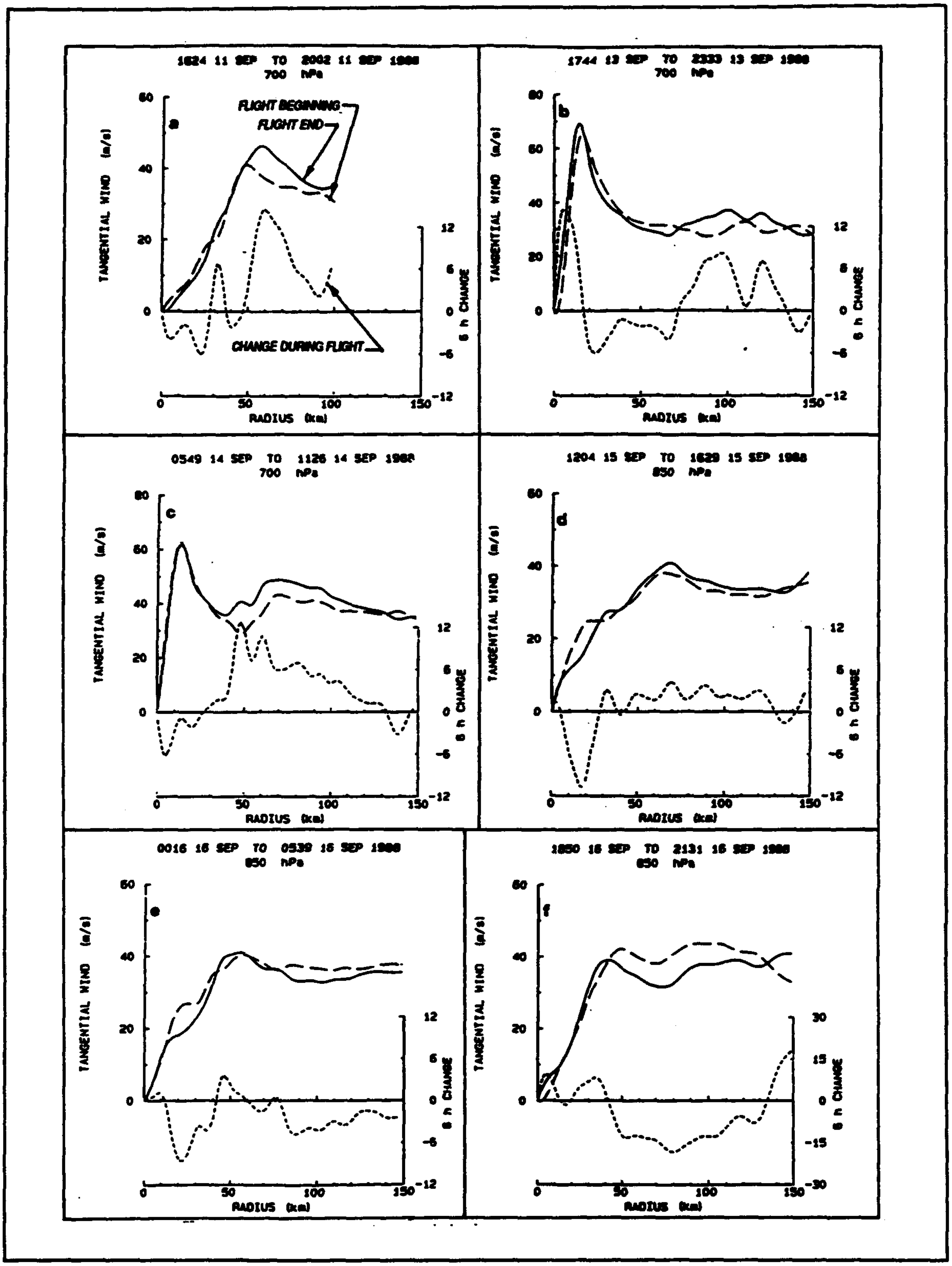

Figure 1. Temporal changes in the azimuthally averaged wind for NOAA reconnaissance flights into Hurricane Gilbert; changes are normalized to a 6-hr time interval (from Black and Willoughby (1992))

Summary of Limitations

The main model limitations described in each category above may be listed as follows:

a. Physics.

(1) Decoupling of boundary layer from full vortex dynamics, precluding mutual adjustment of pressure and wind fields; and feedback of convective scale effects on wind field.

(2) Simplified PBL theory (e.g. constant Ekman scale height).

(3) Extrapolation of Charnock roughness to extreme wind speeds, with no sea state dependence.

(4) No boundary layer adjustment across roughness discontinuity.

b. Initialization.

(1) Constant and homogeneous boundary layer height.

(2) Constant and homogeneous stratification.

(3) Relatively simple pressure specification:

(a) Exponential pressure profile provides only one radius of maximum wind (no concentric rings).

(b) Pressure profile may be inadequate even for unimodal maximum gradient pressure distributions.

(c) Homogeneous ambient linear pressure gradient.

c. Numerics.

(1) Practical limit of spatial resolution to 5 km may be inadequate for very tight storms.

(2) Large number of iterations (800) required for each steady state configuration, or snapshot (using the terminology of Cardone et al. 1992).

In this study, two of the above limitations are addressed and remedied, as described in the next section.

3 Upgraded Model

Increased Resolution

The CE program consists basically of two main programs (Cardone et al. 1992). The first, SNAP, solves the numerical vortex model on a nested grid a number of times to represent the storm wind field at discrete times within an event, thereby producing a number of *snapshot* wind fields on a nested grid. SNAP also writes the snapshots to a file for use by the second main program HIST, which among other functions, interpolates the nested grid solutions to hourly intervals and then interpolates the winds to an output or *target* grid (typically that of an ocean response model).

The nested grid consists of five square 21 by 21 grid point arrays. The grid spacing increases by a factor of two from nest to nest. In the program input, the user specifies a desired spacing of the inner nest (the variable DX in namelist NAME3 of SNAP). For the default value of 5 km, the grid spacing in the coarsest nest becomes 80 km and the entire grid covers an area of (1,600 km^2). While the existing CE program allows users to set DX smaller than 5 km, this is not recommended since the grid coverage shrinks commensurately. The simplified boundary condition applied on the outer boundary of the outermost nest becomes increasingly tenuous as the gridded domain shrinks.

The upgraded program allows the use of up to seven nests. However, the user may specify the number of nests (from three to seven) in a given run. The new parameter INSIDE is used to specify the number of active nests. It designates which is the finest active nest, where nests are numbered from 1 to 7 going from finest to coarsest. For example, INSIDE = 1 activates all seven nests, and INSIDE = 2 activates only nests 2 through 7. The grid spacing of nest 1, the innermost nest, is specified as before with variable DX, regardless of whether or not the nest is active. The relationships between INSIDE, active nests, and spacing of the finest active nest are summarized in Table 1. The default value of DX is 2 km. If all seven nests are exercised, the execution time per snapshot is roughly four times as long as the existing CE model. For this case the number of iterations on the inner nest is set to the default value of 3200.

Table 1
Effect of Nest Activation Parameter, INSIDE

INSIDE	Active Nests	Spacing of Finest Active Nest
1	1 - 7	DX
2	2 - 7	2 DX
3	3 - 7	4 DX
4	4 - 7	8 DX
5	5 - 7	16 DX

The program with the new nesting was tested in two ways using the Hurricane Camille snapshots as test cases. First, vortex model winds were produced by the CE model (and its OWI equivalent) for the case of DX = 8 km. Then, the same SNAP inputs were used to generate winds with the new code for the case DX = 2 km, INSIDE = 3, which provides the equivalent number of nests and inner nest grid spacing as the CE model run. Winds produced by the two alternative programs were interpolated to a target grid covering the Gulf of Mexico (nominal spacing of 0.2 deg[1]), compared and found to agree to within roundoff error of the VAX computer used for these tests.

The second test compared winds for Camille produced by the new code for the case DX = 2 km and INSIDE = 1; that is, all seven nests are live with inner nest grid spacing of 2 km, with winds produced by the CE program with DX = 5 km. These results are shown in Appendix A which gives, at 30-minute intervals, the maximum scalar wind speed, the location and the corresponding wind speeds and directions, and the same data for the maximum vector wind difference magnitude. The results (see also Figure 2) indicate that the largest differences (scalar differences of up to about 7 m/s), occur inside the eyewall, where truncation errors on the 5-km solution are expected to be large for an intense tight vortex such as Camille. Maximum scalar wind speed differences in the area of the eyewall are generally less than 1 m/sec. However, maximum vector difference magnitudes of up to 9 m/sec were observed occasionally in the vicinity of the eyewall reflecting a tendency for the wind direction on the 2-km solution to be turned systematically in the direction of less inflow, by up to 10 deg from the 5-km solution. The 2-km solutions are no doubt the more accurate solutions.

[1] A table of factors for converting non-SI units of measurement to SI units is presented on page vi.

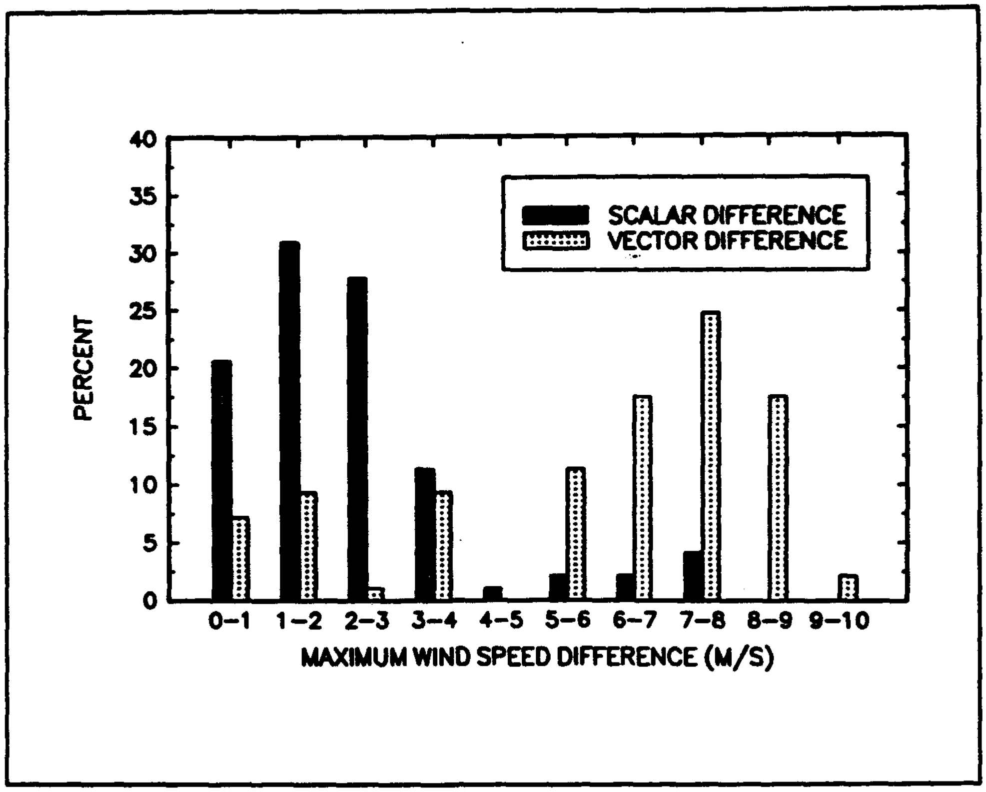

Figure 2. Distribution of maximum wind speed differences between 5-nest and 7-nest model runs for Hurricane Camille

Generalized Pressure Specification

Pressure profile form

The upgrade to the pressure specification uses a generalized form of Holland's (1980) exponential pressure profile

$$p(r) = p_o + \sum_{i=1}^{n} dp_i \, e^{-\left(\frac{R_{pi}}{r}\right)^{B_i}} \qquad (4)$$

where

n = number of components

dp_i = pressure anomaly for the i'th component $(dp_1+dp_2+...+dp_n=p_\infty-p_o)$

R_{pi} = scaling radius for the *i'th* component

B_i = Holland's B coefficient for the *i'th* component

The corresponding tangential and radial pressure gradients are:

$$\frac{\partial p}{\partial \theta} = 0 \qquad \textit{(tangential)}$$

$$\frac{\partial p}{\partial r} = \sum_{i=1}^{n} B_i \, dp_i \left(\frac{R_{pi}}{r}\right)^{B_i} \left(\frac{1}{r}\right) e^{-\left(\frac{R_{pi}}{r}\right)^{B_i}} \qquad \textit{(radial)} \tag{5}$$

The CE model was modified to provide options for a single or double exponential component ($n = 1$ or $n = 2$). This form allows the specification of pressure profiles with two separate maxima in the radial pressure gradient, though the mere form does not guarantee two maxima. For example, the sum of two exponentials also allows the modeling of pressure profiles which have only one maximum but with shapes very different from those predicted by the single exponential even with the variable B included.

Incorporation of this model into the seven-nest version of the program led to extensive changes to program SNAP, in particular to Subroutines GRAD and PXYM and further changes to namelist NAME3, as documented in Appendix B. One immediate consequence of this model is that the quadrantal specification of profile parameters allowed in the single exponential form with $B = 1$ is lost. To retain this option in the CE model portfolio, two versions of the upgraded program were developed as follows:

> SNAP_ADC.7NE and HIST_ADC.7NE - This version only upgrades the current CE program (which includes quadrantal variation of parameters for a single exponential with $B = 1$) to incorporate the additional nests.
>
> SNAP_HOL.7NE - This version upgrades the current CE model to allow both 7 nests and the generalized pressure specification scheme, but without quadrantal variation. Note, however, that asymmetry in the pressure field is still modeled through superposition of the vortex pressure field and the background steering gradient. The background pressure gradient is required to be homogeneous (that is, the parameter ST12 is eliminated).

Modified outflow

In early tests of the upgraded CE program with hypothetical snapshot inputs estimated roughly to apply to several stages of Hurricane Gilbert (inputs for

Gilbert snapshots were derived more rigorously as described below), it was demonstrated that the program could produce the pattern of annular concentric wind maxima. However, it was noticed that the inflow characteristics of the model appeared to have changed somewhat from the unimodal model. In the standard CE model, Subroutine OUTFLOW serves to remove 8 degrees of inflow from the snapshot solution throughout the domain to compensate approximately for inflow believed to be spuriously introduced through the numerical solution. This spurious inflow is revealed by solving the model for a motionless vortex with all friction terms deactivated and comparing the modeled wind direction to the purely circular flow expected of a vortex in gradient balance.

The frictionless, motionless vortex test was repeated with the upgraded model for the series of nine snapshots indicated in Table 2. For the unimodal case (Case 1) and the bimodal cases with $B = 1$ for both exponentials (cases 2 and 6), the maximum inflow (which tends to occur just outside the wind maxima) averages 7.5 deg. As the value of B increases, however, there is a proportional increase in the inflow. In the bimodal profile with B varying between the two exponentials, the inflow varies with radius. Subroutine OUTFLOW was modified to compensate for dependence of spurious inflow on B (Table 3).

Table 2
Maximum Inflow Observed in Frictionless Stationary Vortex Solution[1]

Case	p_o, mb	R_{p1}, nm	R_{p2}, nm	dp_1, mb	dp_2, mb	B_1	B_2	(Max Inflow)$_1$, deg	(Max Inflow)$_2$, deg
1	970	27	0	40	0	1.00	0.00	7.2	—
2	915	8	58	68	27	1.00	1.00	7.3	7.3
3	915	8	58	68	27	1.00	2.00	6.6	13.1
4	915	8	58	68	27	2.52	1.00	18.7	6.6
5	915	8	58	68	27	2.52	2.00	28.8	16.5
6	890	6	42	53	67	1.00	1.00	8.0	7.7
7	890	6	42	53	67	1.00	1.26	8.1	9.1
8	890	6	42	53	67	2.52	1.00	12.7	7.5
9	890	6	42	53	67	2.52	1.26	15.1	9.0

[1] All runs were done with the upgraded CE model with 7 nests and generalized pressure specification; p_∞ = 1010 mb for all runs

Table 3
Empirical Correction of Inflow Angle

Exponential	Reduction Applied To Inflow Angle deg
Unimodal $B = 1$	8
Unimodal $B \neq 1$	$8B$
Bimodal	$8\left(\frac{B_1 + B_2}{2}\right)$

Specification of pressure parameters

Single Exponential Profile: B = 1. In the standard CE model, the pressure profile may be specified in basically two ways. The most fundamental way is to fit the profile to sea level pressure measurements available at different radii at a given time, or transformed from time to space using single station data acquired at a station in the path of the storm. There are several examples of this approach as applied to historical U.S. Gulf of Mexico and East Coast hurricanes in Graham and Hudson (1960). The eye pressure may be prescribed, if it is known, for a more accurate fit, or the eye pressure may be extrapolated from a fit determined exclusively from data outside the center. A simplification to this procedure is often followed for oceanic storms, for which eye pressure may be known from aircraft dropsonde data, far field pressure is estimated from weather maps, and a few estimates of pressure at various radii about the storm are known from ship or island station synoptic reports. Then, the unknown parameter scale radius may be estimated from Equation 1 as follows for each such report and an average or weighted average of the estimates taken to represent the storm profile at map time:

$$R_p = -r \ln\left(\frac{p(r) - p_o}{p_\infty - p_o}\right) \tag{6}$$

If there are insufficient pressure data but eye pressure is known and an estimate of the radius of maximum wind, R_m, is known (e.g. from aircraft vortex message reports filed upon penetration of the eye and assuming that R_m at flight level is the same as R_m at the surface, or more crudely from radar or satellite eye diameter estimates), R_p may be estimated directly from R_m using the average relationship found between these two variables by the vortex model.

Single Exponential Profile: Variable B. Variants of these same two approaches may be followed to estimate the parameters of the generalized unimodal model, for which the additional parameter B must also be specified. Again, if there are sufficient pressure data, the profile may be fitted directly. For example, Figure 3 shows the screen display of a PC-based interactive system developed at OWI using a commercially available plotting/statistical analysis software package. The pressure data are composited (see window in upper right hand corner of screen) as a function of radius in a South China Sea typhoon from reduced (from flight level) aircraft pressures and pressures reported by ships within a 3-hr time window of analysis time. The aircraft also provided estimates of eye pressure (note the two conflicting estimates at the origin in the lower window of Figure 3). Far field pressure was estimated from weather maps. The best fit shown is for p_o = 968 mb, B = 0.8, and R_p = (14 nm)$^{0.8}$. The window at the upper left of the screen compares the azimuthally averaged solution for the model surface wind (downloaded from a run made on a VAX) and reduced aircraft and ship reports of wind.

The second approach is more indirect and emphasizes the use of aircraft wind data. In recent years such data have become quite accurate after the introduction of inertial navigation systems, onboard processing and the availability of coded messages (so-called supplementary or peripheral flight level winds) containing measured winds at flight level outside the eye. Figure 1 shows the complete analysis carried out by Black and Willoughby (1992) of flight data acquired over the main lifetime of Hurricane Gilbert in the Caribbean Sea and Gulf of Mexico. These curves show 12 separate radial profiles of the azimuthally averaged flight level (700 mb or 850 mb) tangential wind speed composited from flight legs near the indicated times. Most of the wind profiles exhibit two distinct wind maxima. On the assumption that the azimuthally averaged flow is approximately in gradient balance with the axisymmetric pressure field, the pressure profile associated with double concentric wind maxima should also exhibit two local maxima in the pressure gradient. Therefore they might be fitted by a double exponential profile. Even those profiles which do not exhibit two distinct peaks, such as those in panels *b, d,* and *e*, exhibit atypical shapes for tropical cyclones, with a single maximum and broad regions with little or no change of wind speed with radius. Nevertheless, we have selected five of these cases to illustrate the fitting of the single exponential profile using aircraft wind data and eye pressure. Parameters are defined in Table 4 and results from the fitting process are given in Table 5.

The fitting method is basically a systematic search of many possible solutions of the single exponential for that solution whose radial distribution of implied gradient wind provides a close match to the location and magnitude of the azimuthal average flight level wind. This searching program (implemented in a preprocessing program called 1EYEWALL.nOL) requires the input information listed in Table 5. Additional documentation is given in Appendix B. The searching program fixes the profile anomaly parameter (p_∞ - p_o), loops through possible values of the scale radius R_p (from R_m to $2R_m$) and B (from 0.5 to 2.52) and finds the pressure profile whose gradient wind simultaneously

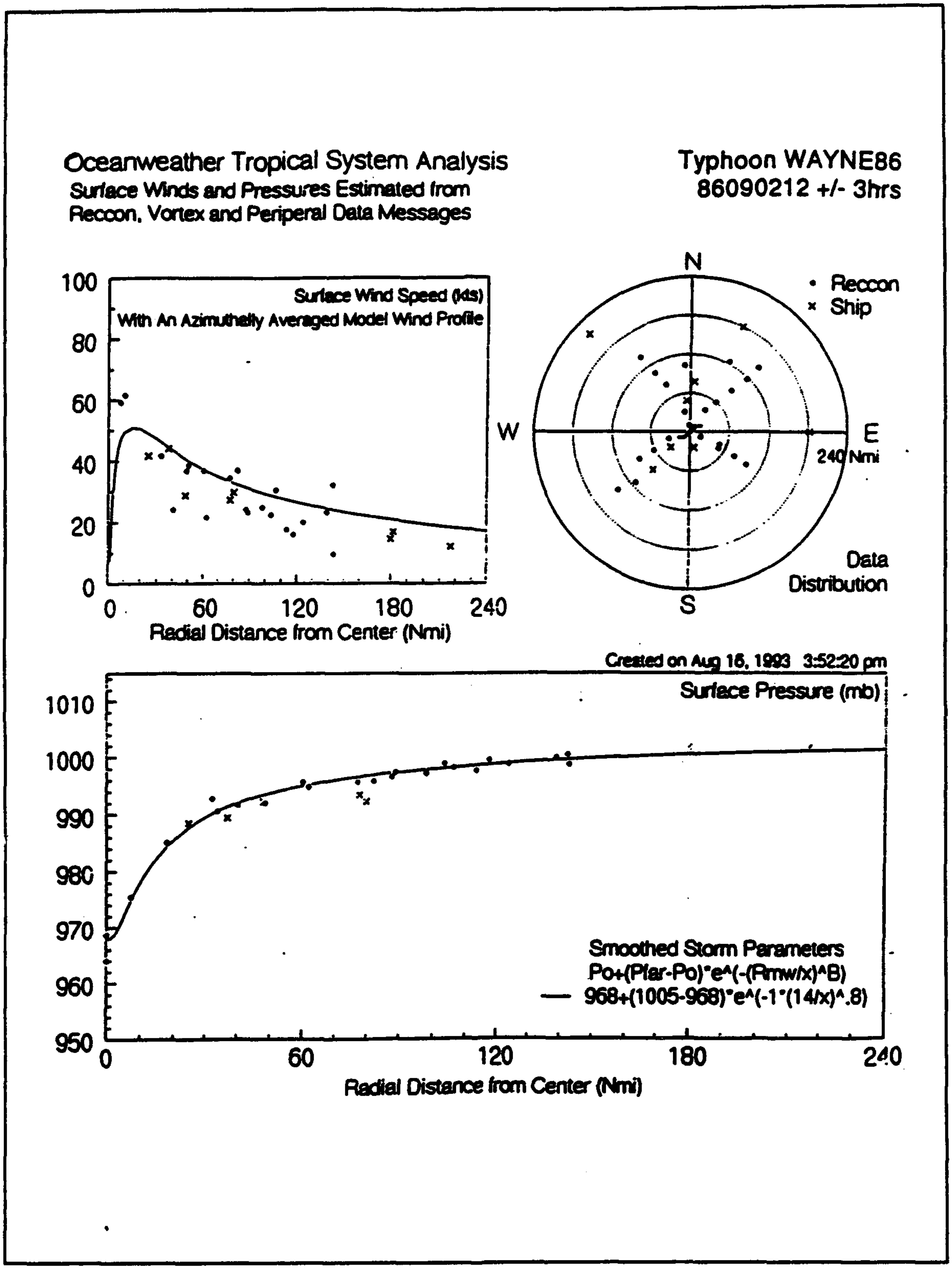

Figure 3. Example of Oceanweather tropical storm analysis

Table 4
Parameter Definitions for Fitting Single Exponential Profile

Parameter	Definition
R_m	Observed radius of maximum wind
V_m	Azimuthally averaged tangential flight level wind at R_m
V_{m150}	Azimuthally averaged tangential flight level wind at 150 km from center
R_p	Scale radius of single exponential profile
dp	Storm pressure anomaly parameter of single exponential profile
B	Holland's B
R_{gm}	Radius of maximum gradient of fitted pressure profile
V_{gm}	Maximum gradient wind of fitted pressure profile
V_{g150}	Gradient wind of fitted profile 150 km from center

Table 5
Generalized Single Exponential Profile Fits to Selected Hurricane Gilbert Cases

	Input					Output					
Case	P_o mb	P_∞ mb	R_m km	V_m m/s	V_{m150} m/s	r_p km	dp mb	B	V_{gm} m/s	R_{gm} km	V_{g150} m/s
3	905	1012	16	65	30	20	107	1.50	67.2	20	21
4	888	1012	13	69	30	16	124	1.41	70.3	16	20
7	951	1012	65	38	36	97	61	1.00	39.3	87	36
8	950	1012	69	41	38	92	62	1.12	42.2	85	38
9	949	1010	57	40	37	85	61	1.12	41.9	79	37

best matches the observed wind speeds at R_m and at 150 km in terms of absolute difference. For example, in Case 3 of Table 5 the selected profile gradient wind (not shown) is within 1 m/s of the V_m of 65 m/s at R_m. However the searching program places the absolute profile maximum of 67.2 m/s at a radius of 20 km, and fails to maintain the observed broad region of little change in wind speed between 50 and 150 km, resulting in a profile wind speed of only 21 m/s at 150 km, about 10 m/s lower than measured. Cases 7, 8 and 9 are somewhat more successful. The parameter B varies between 1.0 and 1.5 for these fits, or in the same general range reported by Holland for a single exponential.

Double Exponential Profile. While it is conceivable that there may be sufficiently voluminous and accurate pressure data in some tropical cyclones to

attempt to directly fit a double exponential profile to measurements of surface pressure as a function of radius, we have not attempted to construct such a data set and perform such a fit. We did try, without success, to develop useful fits to the profile from just the total storm anomaly, estimates of the two radii of maximum wind and a single pressure along the profile in the region between the two maxima. However, a generalization of the searching algorithm described above for a single exponential has met with some success.

The searching algorithm (called 2EYEWALL.HOL) as applied to a double exponential is documented in Appendix B. Parameters involved are defined in Table 6 and Figure 4. The searching program fixes the total storm anomaly, assumes the scale radius for the inner exponential is equal to the observed radius of maximum wind of the inner maximum, or ring, and loops through ranges of the outer scale radius, R_{p2} (from R_{m2} to $2R_{m2}$), inner and outer B (from 0.5 to 2.52) and the ratio of dp_1/dp_2 (from 1/8 to 8). The algorithm seeks the combination whose pressure profile provides a gradient wind profile that has maxima at R_{m1} and R_{m2} within ±1 m/s of observed and which maximizes the following:

$$V_{g1} + V_{g2} - 2\,V_{gm} \tag{7}$$

where

V_{gm} = gradient wind at $(R_{m1}+R_{m2})/2$

If it succeeds in finding such a profile it checks that the wind at 150 km is lower than the outer maximum, V_{m2}, and if it is, prints the solution. If these conditions are not met, another cycle is attempted. The matching criterion is relaxed to ±2 m/s, this time requiring that the wind at $(R_{m1}+R_{m2})/2$ is less than the winds prescribed at R_{m1} and R_{m2}, and minimizing the wind at 150 km. The program also prints the profile parameters for the selected profile. If, after the second cycle the program still does not find a successful fit, it prints the closest fit found in each cycle.

Table 7 shows the results of the application of this searching algorithm to all 12 of the azimuthal average tangential flight level wind profiles in Hurricane Gilbert derived by Black and Willoughby (1992). The double exponential appears to require large values of B to resolve two distinct peaks in the radial profile of gradient wind, at least for most of these cases. Table 8 compares the location and magnitude of the double wind maxima derived from the fitted profile to those observed. Figure 5 compares the fitted and observed radial profiles of pseudo-gradient wind. The inner ring is usually fitted very closely. In 11 out of 12 of the cases a distinct outer wind maximum is resolved, and it is usually placed within ±20 km of the observed maximum. In 9 out of those 11 cases, the maximum is within about ±2 m/s of that observed. Case 8 is the poorest fit, but in practice Case 7 and Case 8 are so close in time

Table 6
Parameter Definitions for Fitting Double Exponential Profile

Parameter	Definition
R_{m1}	Radius of maximum wind, inner ring
R_{m2}	Radius of maximum wind, outer ring
V_{m1}	Azimuthally averaged tangential flight level wind, inner ring
V_{m2}	Azimuthally averaged tangential flight level wind, outer ring
R_{p1}	Scale radius, inner exponential
R_{p2}	Scale radius, outer exponential
dp_1	Pressure anomaly, inner exponential
dp_2	Pressure anomaly, outer exponential
B_1	Holland's B, inner exponential
B_2	Holland's B, outer exponential
R_{g1}	Radius of maximum gradient wind of fitted profile, inner ring
R_{g2}	Radius of maximum gradient wind of fitted profile, outer ring
V_{g1}	Maximum gradient wind of fitted profile, inner ring
V_{g2}	Maximum gradient wind of fitted profile, outer ring

(in fact they are derived from the same flight) that Case 7 may be used to represent this phase of the storm history.

Sample Runs

The upgraded program, including seven nests and the generalized pressure specification, has been applied to provide sample wind fields on target grids using as test input the snapshots developed for Hurricane Gilbert. Two runs were made. The first generates a snapshot wind field for each of the 12 Gilbert cases (including realistic forward motion and steering flow parameters) and interpolates each snapshot to a polar grid using a test history table. Interpolations are also made from pairs of adjacent snapshots (equal time weight). Winds for the 23 wind fields so produced on the polar grid are then azimuthally averaged. These results are given in Appendix C.

A second test run was made which modeled Gilbert during its passage across the Gulf of Mexico between 1200 UT 15 September through 0000 UT 17 September, 1988. Snapshots for this run consisted of Cases 7, 9, 11, and 12. The target grid for this run was a grid of nominal 12 nm spacing covering the Gulf of Mexico. The wind fields were output at 12-hourly intervals. Additional details and surface wind field plots are given in Appendix D.

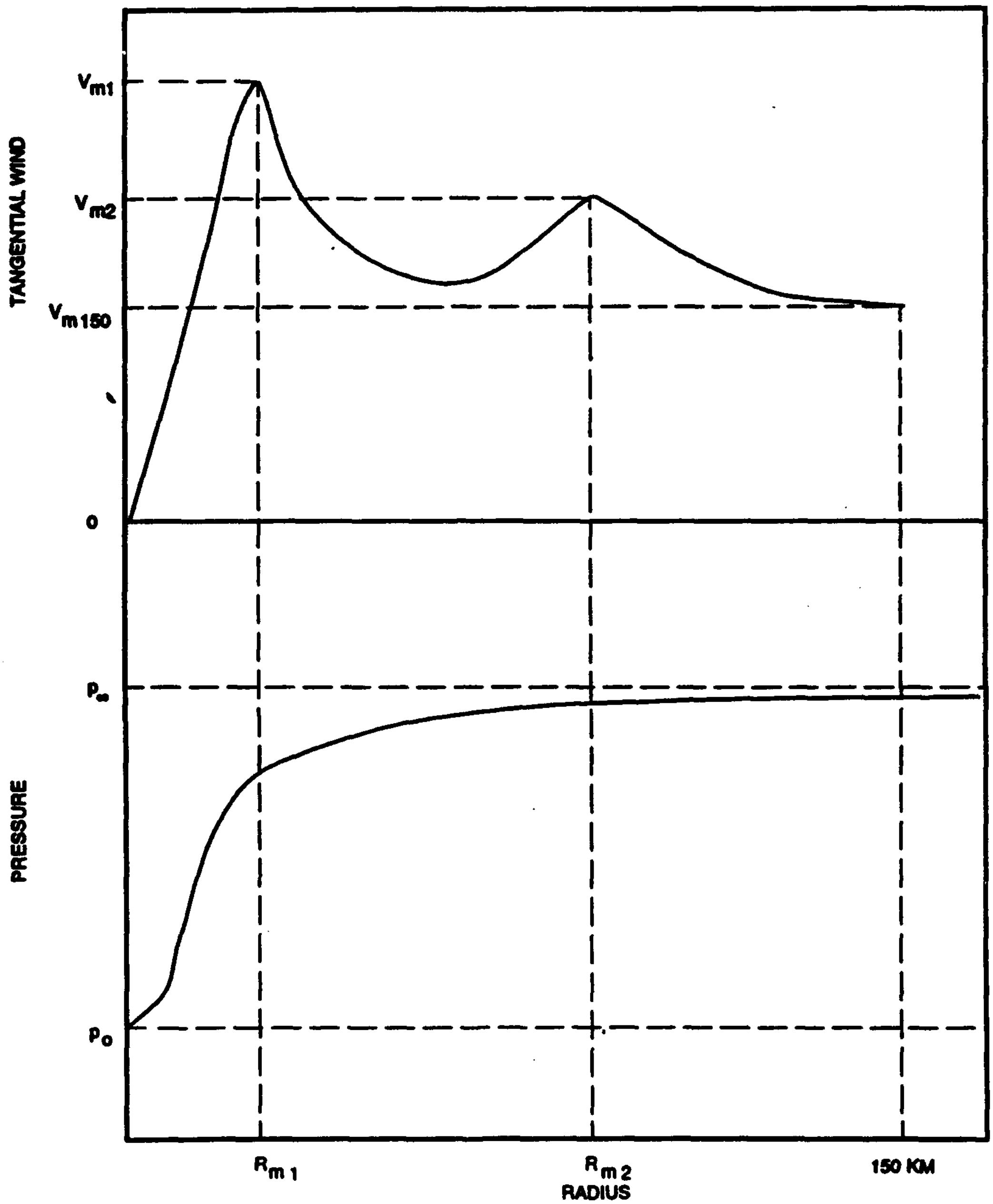

Figure 4. Some parameters in double exponential profile

Table 7
Observed Pressure and Azimuthally Averaged Pseudo-Gradient Wind Maxima in Hurricane Gilbert[1] and Estimated Generalized Profile Parameters

Case	Date/ Time (UTC)	Input						Output					
		p_o mb	p_∞ mb	R_{m1} km	R_{m2} km	V_{m1} m/s	V_{m2} m/s	R_{p1} km	R_{p2} mb	dp_1 mb	dp_2 mb	B_1	B_2
1	11/1624	972	1011	47	90	40	35	47	127	23	16	2.52	2.52
2	11/2002	968	1011	58	108	47	36	58	162	32	11	2.52	2.52
3	13/1744	905	1012	16	111	65	32	16	125	94	13	1.68	2.39
4	13/2333	888	1012	13	100	69	38	13	100	110	14	1.59	2.52
5	14/0549	893	1012	13	70	62	44	13	70	101	18	1.41	2.52
6	14/1126	890	1012	13	69	62	48	13	69	102	20	1.41	2.52
7	15/1204	951	1012	22	65	25	38	22	87	45	16	0.56	2.52
8	15/1629	950	1012	32	69	28	41	32	103	35	27	0.94	2.51
9	16/0016	949	1010	22	57	27	40	22	81	41	20	0.75	2.52
10	16/0539	950	1011	55	120	41	37	55	170	52	9	1.12	2.24
11	16/1850	953	1010	50	100	42	43	50	119	47	10	1.33	2.52
12	16/2131	954	1009	40	100	39	40	40	112	45	10	1.19	2.52

[1] Cases correspond to Black and Willoughby's (1992) analysis of aircraft data in Hurricane Gilbert

Table 8
Comparison of Measured Flight-Level Wind Maxima and Fitted Gradient Wind Maxima for Double Exponential Pressure Profile[1]

Case	Inner Ring				Outer Ring				
	Measured		Fitted		Measured		Fitted		
	R_{m1} km	V_{m1} m/s	R_{g1} km	V_{g1} m/s	R_{m2} km	V_{m2} m/s	R_{g2} km	V_{g2} m/s	V_g at R_{m2} m/s
1	47	40	47	39.6	90	35	110	37.1	35.7
2	58	47	58	46.6	108	36	108[2]	35.7[2]	—
3	16	65	16	66.7	111	32	105	33.7	33.6
4	13	69	13	70.3	100	38	85	37.2	36.3
5	13	62	13	63.5	70	44	59	46.2	45.4
6	13	62	13	63.7	69	48	59	48.4	47.3
7	22	25	22	26.3	65	38	82	39.2	36.1
8	32	28	30	29.7	69	41	98	48.1	39.2
9	22	27	21	28.9	57	40	78	43.4	38.1
10	55	41	55	39.2	120	37	120	37.1	—
11	50	42	50	40.7	100	43	93	41.5	41.3
12	40	39	40	32.9	100	40	92	38.4	38.2

[1] Cases correspond to Black and Willoughby's (1992) analysis of Hurricane Gilbert
[2] Second ring maximum not resolved, profile gradually decays from inner maximum

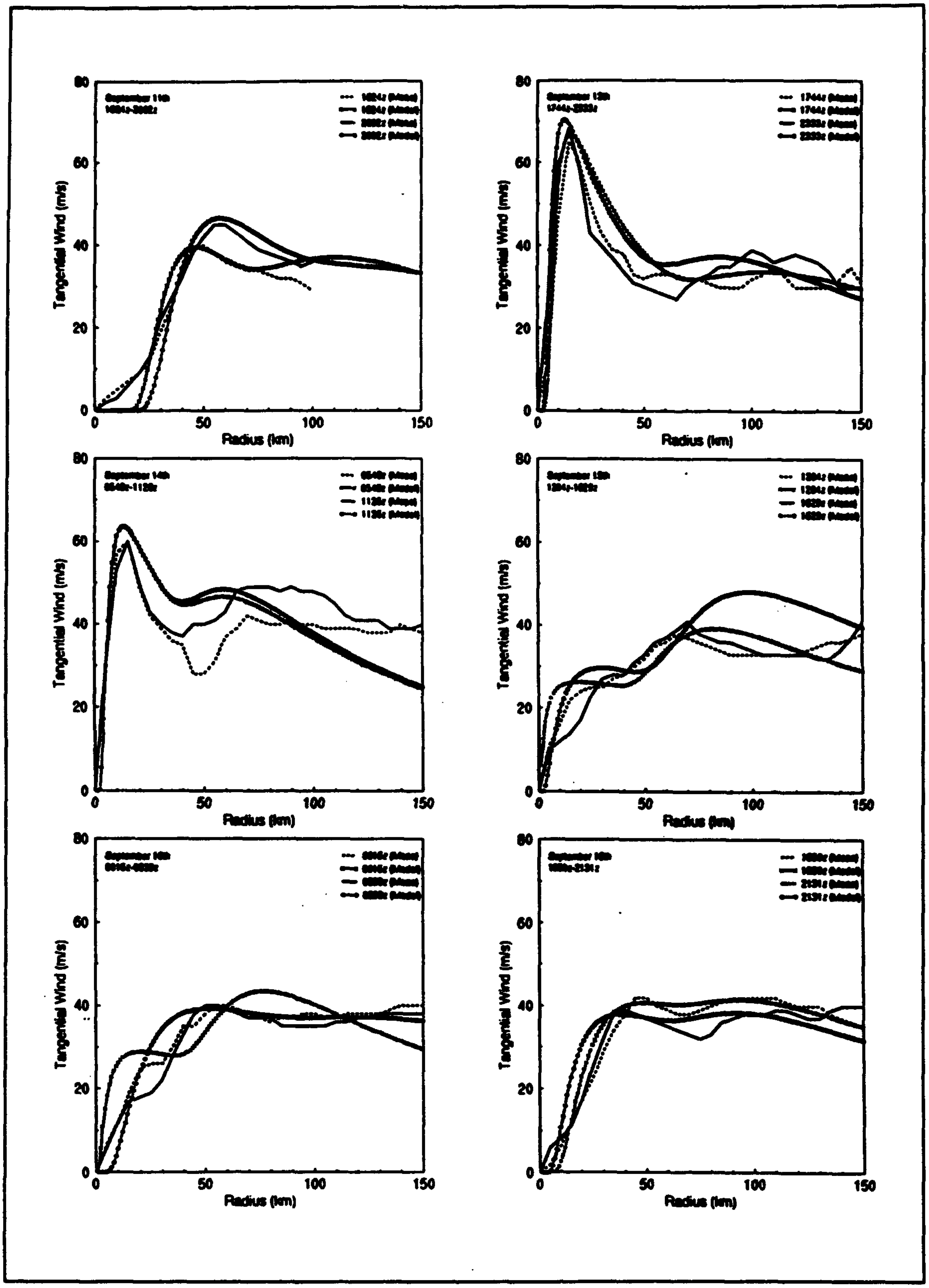

Figure 5. Comparison of azimuthally averaged reconnaissance winds and fitted gradient winds in 12 cases of Hurricane Gilbert defined by Black and Willoughby (1992)

4 Summary

The CE tropical cyclone surface wind field model has been a very useful tool in ocean response modeling for more than a decade. The model continues to be used regularly. The CE recently held a workshop to reassess model assumptions, particularly in light of modern advances in computing technology and field measurement of hurricane structure. Model limitations were identified and evaluated in terms of their perceived importance to ocean response modeling and the level of effort required to develop improved solutions. The limitations are summarized in this report.

Two aspects of the CE model were targeted for improvement. This report describes the improvements developed for the upgraded model. First, the standard CE model represents a compromise between spatial resolution in the central region of very high gradients, coverage of the full ocean area affected by the tropical cyclone, and computer requirements. Computing resources are much more available now than at the time the model was developed in the late 1970's. The model was upgraded to include more computationally intensive options which give improved resolution and areal coverage. Up to seven nested grids are now available, compared to only five nests in the standard model. In a typical application, this upgrade can be used to achieve 2-km resolution around the eye (as compared to 5-km resolution often used in the standard model) and an expanded total coverage area.

The second upgrade to the standard CE model allows a more general specification of the axisymmetric pressure profile. This upgrade can be used to create wind fields with maxima at two different radii or with a broad maximum extending over a range of radii. It also provides more flexibility in fitting the shape of single peaked wind profiles.

The upgraded model is demonstrated with historical hurricanes. The five-nest and seven-nest models are applied to Hurricane Camille. The fully upgraded model, with seven nests and general pressure specification, is applied to Hurricane Gilbert. This hurricane was chosen because it is well-documented by Black and Willoughby (1992) and it evolved into some non-traditional storm structures. The upgraded model was more effective than the standard CE model in simulating the storm.

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Appendix A
Comparison of Five-Nest and Seven-Nest Models for Hurricane Camille

Comparison of modeled winds at 20-m height and at 30-min intervals in alternative hindcasts of Hurricane Camille in the Gulf of Mexico during August 1969. The run labelled "5-Nests" used the standard CE model with 5-km spacing on the inner nest. The run labelled "7-Nests" used the upgraded CE model with seven-nests and grid spacing of 2 km on the inner nest. The first (second) line at each time step gives: maximum scalar (vector magnitude) wind speed difference found on the grid between the two runs, latitude and longitude of the grid point, and wind speed and direction of the alternative solutions at that grid point.

Table A1
Comparison of Wind Estimates from 5-Nest and 7-Nest Models, Hurricane Camille

Day/ Hour	Max. Speed Diff. m/s	Grid Point Coord.		5-Nest Model		7-Nest Model	
		Lat. deg	Long. deg	Speed m/s	Dir. deg az	Speed m/s	Dir. deg az
161200	7.1 8.4	24.1 24.1	-85.7 -85.7	27.9 27.9	151.7 151.7	20.8 20.8	162.6 162.6
161230	3.0 6.0	24.1 24.1	-86.0 -85.7	39.7 42.0	338.6 172.2	36.7 43.1	342.5 180.1
161300	1.2 7.0	24.1 24.3	-85.7 -86.0	41.6 52.6	181.0 47.1	42.8 52.9	183.7 54.6
161330	2.2 7.2	24.3 24.3	-86.0 -86.0	43.6 43.6	78.8 78.8	41.4 41.4	88.0 88.0
161400	1.5 6.7	24.3 24.3	-86.0 -86.2	38.1 51.0	131.1 2.0	36.7 50.1	140.6 9.5
161430	3.4 7.3	24.3 24.3	-86.2 -86.0	40.7 43.5	359.4 150.1	37.3 45.2	5.4 159.3
161500	2.1 5.3	24.3 24.5	-86.2 -86.2	21.2 53.0	312.9 52.8	23.2 54.0	306.1 58.3
161530	2.4 8.2	24.3 24.5	-86.2 -86.2	31.2 49.6	240.3 80.5	33.6 49.2	242.5 90.0
161600	1.0 8.9	24.3 24.5	-86.4 -86.2	46.5 47.6	312.6 108.6	45.5 46.9	316.1 117.4
161630	3.8 6.2	24.5 24.5	-86.4 -86.2	39.5 46.3	16.6 138.6	35.7 47.9	22.6 145.9
161700	1.5 3.6	24.5 24.8	-86.4 -86.4	9.8 53.0	339.9 57.2	8.4 54.1	342.7 60.8
161730	1.9 5.4	24.5 24.8	-86.4 -86.4	23.2 52.2	226.5 74.4	25.1 52.9	232.6 80.2
161800	2.0 6.9	24.5 24.8	-86.4 -86.4	36.8 49.9	209.7 103.1	38.8 51.0	212.5 110.8
161830	3.4 7.0	24.8 24.8	-86.7 -86.7	43.7 43.7	27.9 27.9	40.3 40.3	36.3 36.3
161900	2.1 3.0	24.8 25.0	-86.7 -86.7	14.7 53.2	2.9 53.0	12.7 54.2	359.3 55.9
161930	2.8 6.0	24.8 25.0	-86.7 -86.7	25.2 52.0	226.3 76.3	28.0 52.6	231.6 82.9
162000	1.9 7.9	24.8 25.0	-86.7 -86.7	36.1 48.9	217.8 102.0	38.0 49.9	219.8 111.1
162030	3.1 7.2	25.0 25.0	-86.9 -86.9	44.4 44.4	20.2 20.2	41.3 41.3	28.9 28.9

(Sheet 1 of 6)

Table A1 (Continued)							
		Grid Point Coord.		5-Nest Model		7-Nest Model	
Day/ Hour	Max. Speed Diff. m/s	Lat. deg	Long. deg	Speed m/s	Dir. deg az	Speed m/s	Dir. deg az
162100	1.2 3.2	25.0 25.0	-86.7 -86.7	44.1 44.1	159.6 159.6	45.3 45.3	163.4 163.4
162130	2.4 6.8	25.0 25.3	-86.9 -86.9	24.7 51.9	255.5 68.2	27.0 52.2	257.8 75.7
162200	1.7 9.3	25.2 25.2	-86.9 -86.9	47.8 47.8	95.4 95.4	46.2 46.2	106.5 106.5
162230	2.8 7.6	25.2 25.2	-87.1 -86.9	45.4 46.9	13.3 132.4	42.6 46.9	22.2 141.6
162300	1.6 3.7	25.2 25.2	-86.9 -86.9	43.4 43.4	163.1 163.1	44.9 44.9	167.5 167.5
162330	2.1 7.7	25.2 25.4	-87.1 -87.1	26.5 51.0	267.8 64.2	28.6 51.3	268.0 72.8
170000	1.8 8.2	25.4 25.4	-87.1 -87.1	44.0 44.0	94.1 94.1	42.2 42.2	104.8 104.8
170030	1.2 6.1	25.4 25.4	-87.4 -87.4	48.6 48.6	345.6 345.6	47.3 47.3	352.7 352.7
170100	2.2 7.2	25.4 25.6	-87.4 -87.4	41.8 51.9	313.1 29.6	39.6 51.8	318.0 37.5
170130	2.4 5.0	25.6 25.6	-87.4 -87.1	31.0 45.7	7.0 149.9	28.6 46.8	6.2 155.9
170200	0.9 7.8	22.6 25.8	-88.5 -87.4	8.4 51.4	265.9 54.0	7.4 51.4	271.6 62.7
170230	7.3 9.0	25.8 25.8	-87.4 -87.4	19.8 19.8	104.9 104.9	12.6 12.6	124.3 124.3
170300	3.5 6.7	25.8 26.0	-87.4 -87.4	28.9 51.2	221.5 81.4	32.3 52.0	226.8 88.8
170330	1.0 7.5	26.0 26.0	-87.6 -87.4	51.3 42.1	7.4 121.2	50.4 41.2	14.3 131.4
170400	2.8 5.5	26.0 26.0	-87.6 -87.4	38.2 41.5	333.4 175.3	35.4 42.9	336.4 182.5
170430	2.9 7.6	26.2 26.2	-87.6 -87.6	45.2 45.2	39.4 39.4	42.3 42.3	48.6 48.6
170500	1.3 3.7	26.2 26.4	-87.4 -87.6	44.2 53.4	161.7 53.5	45.5 54.4	164.7 57.3
170530	1.7 8.1	26.2 26.4	-87.6 -87.6	32.2 46.2	250.2 78.9	34.1 45.2	251.5 89.0

(Sheet 2 of 6)

Table A1 (Continued)

Day/ Hour	Max. Speed Diff. m/s	Grid Point Coord.		5-Nest Model		7-Nest Model	
		Lat. deg	Long. deg	Speed m/s	Dir. deg az	Speed m/s	Dir. deg az
170600	6.9 8.1	26.4 26.4	-87.6 -87.6	22.5 22.5	163.9 163.9	15.7 15.7	177.4 177.4
170630	2.5 5.2	26.4 26.4	-87.6 -87.6	37.7 37.7	192.9 192.9	40.2 40.2	199.6 199.6
170700	4.0 6.7	26.6 26.6	-87.8 -87.8	42.8 42.8	29.2 29.2	38.8 38.8	36.7 36.7
170730	2.4 3.4	26.6 26.6	-87.8 -87.8	6.5 6.5	353.2 353.2	4.1 4.1	20.6 20.6
170800	3.2 7.9	26.6 26.8	-87.8 -87.8	30.1 51.4	229.2 81.1	33.2 51.1	234.5 89.9
170830	1.5 7.3	26.8 26.8	-88.0 -87.8	49.3 41.8	7.7 129.6	47.8 40.9	16.1 139.7
170900	2.9 6.3	26.8 26.8	-88.0 -87.8	35.2 43.9	344.8 163.9	32.3 45.6	345.8 171.6
170930	0.9 8.6	24.5 27.0	-90.1 -88.0	8.8 49.4	290.2 53.7	8.0 48.5	296.4 63.7
171000	5.9 6.6	27.0 27.0	-88.0 -88.0	19.5 19.5	102.7 102.7	13.6 13.6	113.0 113.0
171030	1.4 6.4	27.0 27.0	-88.3 -88.0	45.3 32.6	342.6 186.0	43.9 33.3	349.2 197.1
171100	2.0 7.1	27.0 27.2	-88.3 -88.3	39.4 51.2	312.5 31.4	37.3 50.1	315.8 39.4
171130	2.3 5.3	27.2 27.2	-88.3 -88.0	26.3 48.7	24.5 145.2	24.0 49.6	20.5 151.4
171200	1.0 6.3	27.2 27.4	-88.0 -88.3	45.1 52.9	168.0 64.7	46.1 53.4	170.2 70.4
171230	3.7 5.8	27.4 27.4	-88.3 -88.3	39.6 39.6	96.0 96.0	35.9 35.9	102.8 102.8
171300	1.8 7.1	27.4 27.4	-88.5 -88.3	44.1 35.3	346.3 180.2	42.4 33.6	352.7 191.7
171330	1.7 7.5	27.4 27.6	-88.5 -88.3	40.1 50.7	313.1 111.3	38.4 51.0	316.2 119.7
171400	1.4 5.9	27.6 27.6	-88.5 -88.3	28.0 48.2	12.5 149.0	26.6 49.5	8.4 155.8
171430	2.3 8.4	27.6 27.8	-88.5 -88.5	30.2 48.7	280.3 58.4	32.6 47.3	279.7 68.2

(Sheet 3 of 6)

Table A1 (Continued)							
		Grid Point Coord.		5-Nest Model		7-Nest Model	
Day/ Hour	Max Speed Diff. m/s	Lat. deg	Long. deg	Speed m/s	Dir. deg az	Speed m/s	Dir. deg az
171500	6.0 6.8	27.8 27.8	-88.5 -88.5	19.3 19.3	114.2 114.2	13.3 13.3	125.6 125.6
171530	1.7 6.5	27.8 28.0	-88.7 -88.5	45.9 52.5	338.5 81.4	44.2 53.2	342.8 88.4
171600	1.6 7.6	28.0 28.0	-88.5 -88.5	41.8 41.8	126.4 126.4	40.1 40.1	136.8 136.8
171630	1.7 7.5	28.0 28.0	-88.7 -88.5	34.0 45.2	338.7 169.1	32.3 46.3	338.4 178.4
171700	3.1 7.5	28.3 28.3	-88.7 -88.7	44.9 44.9	45.2 45.2	41.8 41.8	54.2 54.2
171730	2.0 3.2	28.3 28.5	-88.7 -88.7	6.9 53.8	324.1 59.8	4.9 53.9	340.6 63.2
171800	2.6 8.5	28.3 28.5	-88.7 -88.7	33.7 47.2	240.9 81.6	36.4 45.0	246.3 91.9
171830	7.8 8.3	28.5 28.5	-88.7 -88.7	24.5 24.5	167.5 167.5	16.7 16.7	175.6 175.6
171900	2.5 8.9	28.5 28.7	-88.7 -88.7	38.2 50.1	214.3 97.5	40.7 49.6	221.1 107.7
171930	2.9 7.7	28.7 28.7	-89.0 -88.7	41.2 41.2	1.6 154.8	38.3 40.8	6.5 165.5
172000	1.8 7.2	28.7 28.9	-88.7 -89.0	43.2 50.0	192.8 38.1	45.0 49.0	197.7 46.4
172030	1.5 7.1	28.9 28.9	-88.7 -88.7	47.9 47.9	150.2 150.2	49.4 49.4	158.3 158.3
172100	2.0 8.2	28.9 29.1	-89.0 -89.0	31.1 47.6	283.6 55.6	33.2 46.1	283.5 65.4
172130	3.1 3.5	29.1 29.1	-89.0 -89.0	15.6 15.6	79.7 79.7	12.5 12.5	86.5 86.5
172200	3.6 8.5	29.1 29.3	-89.0 -89.0	27.7 50.1	250.0 72.7	31.3 49.6	255.4 82.6
172230	7.2 8.2	29.3 29.3	-89.0 -89.0	23.8 23.8	135.6 135.6	16.6 16.6	147.2 147.2
172300	1.6 7.1	29.3 29.5	-89.0 -89.0	37.8 51.5	205.3 93.0	39.4 52.0	214.6 100.9
172330	2.2 6.2	29.5 29.5	-89.2 -89.0	44.9 39.1	7.8 143.3	42.7 37.6	15.1 152.3

(Sheet 4 of 6)

Table A1 (Continued)							
		Grid Point Coord.		5-Nest Model		7-Nest Model	
Day/ Hour	Max. Speed Diff. m/s	Lat. deg	Long. deg	Speed m/s	Dir. deg az	Speed m/s	Dir. deg az
180000	1.7 5.5	29.5 29.5	-89.0 -89.0	43.4 43.4	188.7 188.7	45.1 45.1	195.4 195.4
180030	1.8 6.0	29.7 29.7	-89.2 -89.0	27.4 49.7	30.7 142.6	25.6 50.7	26.6 149.4
180100	3.2 8.4	29.7 29.9	-89.2 -89.2	27.0 50.6	274.3 62.6	30.2 49.5	276.4 72.1
180130	6.9 8.0	29.9 29.9	-89.2 -89.2	20.1 20.1	126.8 126.8	13.2 13.2	141.7 141.7
180200	1.4 7.1	29.9 29.9	-89.2 -89.2	36.5 36.5	197.3 197.3	37.9 37.9	208.1 208.1
180230	2.9 9.2	30.1 30.1	-89.4 -89.2	43.9 46.9	16.8 132.5	41.0 45.5	24.2 143.9
180300	1.4 6.0	30.1 30.3	-89.2 -89.4	45.9 52.0	176.3 47.1	47.3 52.1	181.7 53.6
180330	2.5 3.3	30.3 30.3	-89.4 -89.2	23.1 49.9	71.2 139.7	20.6 50.5	66.5 143.4
180400	1.9 3.6	30.3 30.3	-89.4 -89.4	24.1 24.1	245.7 245.7	26.0 26.0	252.7 252.7
180430	0.9 1.4	28.3 30.3	-92.2 -89.4	8.4 38.9	293.9 234.0	7.5 39.7	299.6 235.6
180500	0.9 1.4	28.3 29.5	-92.2 -94.0	8.3 4.4	291.2 353.8	7.5 4.3	296.5 11.9
180530	0.9 1.5	28.5 30.3	-92.2 -89.4	8.8 39.5	292.6 236.7	7.9 38.8	298.1 234.8
180600	0.9 1.4	28.5 29.5	-92.4 -93.3	7.8 6.5	293.4 334.2	7.0 6.0	299.2 345.8
180630	0.9 1.3	28.7 29.7	-92.4 -92.9	7.5 8.0	293.6 328.1	6.6 7.2	299.3 336.0
180700	0.9 1.3	29.5 29.5	-92.6 -92.6	7.6 7.6	315.2 315.2	6.7 6.7	322.1 322.1
180730	0.9 1.1	29.5 29.5	-92.6 -92.6	6.7 6.7	310.7 310.7	5.8 5.8	317.2 317.2
180800	0.9 1.1	29.5 29.5	-92.4 -92.4	6.8 6.8	301.6 301.6	5.9 5.9	306.7 306.7
180830	0.9 1.0	29.7 29.7	-92.2 -92.0	7.2 8.2	298.6 294.2	6.3 7.3	302.9 298.0

(Sheet 5 of 6)

Table A1 (Concluded)

Day/ Hour	Max. Speed Diff. m/s	Grid Point Coord.		5-Nest Model		7-Nest Model	
		Lat. deg	Long. deg	Speed m/s	Dir. deg az	Speed m/s	Dir. deg az
180900	0.9	29.7	-92.0	7.2	289.3	6.3	292.2
	0.9	29.7	-92.0	7.2	289.3	6.3	292.2
180930	0.9	29.7	-92.0	6.3	282.5	5.5	284.1
	0.9	30.3	-89.4	17.4	218.1	17.3	215.2
181000	0.8	29.7	-92.0	5.5	275.1	4.7	274.8
	0.8	30.3	-89.4	15.8	216.9	15.8	213.8
181030	0.7	29.7	-92.0	4.8	265.3	4.1	262.5
	0.8	30.3	-86.4	11.9	161.5	12.1	165.0
181100	0.5	29.7	-91.7	4.9	253.5	4.3	249.7
	0.8	30.3	-86.4	11.4	162.2	11.5	165.9
181130	0.4	28.3	-83.4	8.2	156.8	8.5	160.7
	0.8	30.1	-85.7	10.0	160.4	10.2	164.6
181200	0.4	29.7	-93.8	3.1	170.9	3.5	170.8
	0.8	30.3	-86.4	10.3	163.0	10.4	167.3

(Sheet 6 of 6)

Appendix B Documentation of CE Model Upgrades

This appendix provides brief documentation of new and modified programs in the upgraded CE tropical cyclone surface wind field model. The material is a supplement to the primary documentation of Cardone et al. (1992). Five FORTRAN programs are discussed. The programs HIST_ADC.7NE, SNAP_ADC.7NE, and SNAP_HOL.7NE are modified versions of the previous HIST and SNAP programs. Programs 1EYEWALL.HOL and 2EYEWALL.HOL are new. They are helpful in implementing the new generalized surface pressure specification.

Program HIST_ADC.7NE

HIST_ADC.7NE is a slight modification of HIST_ADC.F. All input files except LSNAP, and all output files, are unchanged from HIST_ADC.F to HIST_ADC.7NE. The changes to file LSNAP are as follows:

- pressure arrays, formerly dimensioned (21,21,5), are now dimensioned (21,21,7);

- wind arrays, formerly dimensioned (21,21,10), are now dimensioned (21,21,14);

- in the variables at the end of records in LSNAP, variable DX is followed by the new variable INSIDE. INSIDE is an integer indexing the innermost live nest of the 7 nests supported, so that the effective grid spacing is DX*2**(INSIDE-1) .

Program SNAP_ADC.7NE

SNAP_ADC.7NE is derived from SNAP_ADC.F. The modifications allow the user to run up to 7 grid nests rather than the previous mandatory 5 nests.

Arrays of pressure, pressure gradient, wind, formerly dimensioned (21,21,5), are now dimensioned (21,21,7). Two changes are made to namelist /NAME3/ as follows:

- a variable name NOMEN (CHARACTER*4) for storm identification has been included;

- integer variable INSIDE has been added. INSIDE indexes the finest live nest of the 7 nests provided. Thus the number of live nests is (8-INSIDE), and the grid spacing of the finest live nest is DX*2**(INSIDE-1). Default values are DX = 2. and INSIDE = 1, yielding a 2 km grid spacing and an execution time roughly 4 times as long as the existing 5-nest model. The combination DX = 6.25, INSIDE = 3, (lines 304, 305) reproduces the 25 km spacing often used by the CE for global studies. In the great majority of applications, the useful values of INSIDE are 1, 2, and 3. INSIDE = 4 may be tried for running a quick preliminary study on a coarse grid.

Program SNAP_HOL.7NE

SNAP_HOL.7NE is an extensive modification of SNAP_ADC.7NE to include the generalized pressure profile as well as the capability for modeling up to 7 nests. The variable ST12 and the quadrantal variation of PFAR and RADIUS have been excised. In OWI's experience with the hurricane model, they have been used only once: for hurricane Eloise, September 13, 1975. Variable ITRACK has been excised: its use pertained to a 1969 study in which direction was specified in points. Namelist /NAME3/ is changed materially. Each variable and array in /NAME3/ is documented below. The method of computation of pressure and pressure gradient is discussed in a later part on Mathematical Method.

Revisions at beginning of program

```
 REAL RADIUS(2),DPRESS(2),HOLL(2)
 CHARACTER*4 NOMEN
 EQUIVALENCE (RAD1,RADIUS), (RAD2,RADIUS(2)), (B1,HOLL),
$ (B2,HOLL(2)), (DP1,DPRESS), (DP2,DPRESS(2))
 NAMELIST /NAME3/ SGW, AN1, NOMEN,
$ EYELAT, EYLONG, DIREC, SPEED, EYPRES, RADIUS, RAD1,
$ RAD2, PFAR, NM, DX, INSIDE, HOLL, B1, B2, DPRESS, DP1,
$ DP2
```

Definition of variables in namelist NAME3

SGW	Magnitude of surface geostrophic wind, m/sec
AN1	Angle between SGW and east, counterclockwise from east
NOMEN	Designator for tropical storm, e.g. two digits and one letter
EYELAT	Latitude of eye of storm at snap time, north positive
EYLONG	Longitude of eye of storm at snap time, east positive (EYLONG is included for archival purposes but not presently used in computation)
DIREC	Direction of forward motion of storm, clockwise from north
SPEED	Speed of forward motion, in kt (but redefinable according to the switch variable UNITS)
EYPRES	Pressure at eye of storm, in mb
RADIUS	Scale radius of the two components of exponential pressure profile
RAD1,RAD2	Alternate names for specifying RADIUS; convenient when only one exponential is modeled
PFAR	Ambient pressure exterior to storm, in mb
NM	Number of computational cycles in nest 1; NM should be a multiple of 64 (default: NM = 3200)
DX	Grid spacing in nest 1, in km (default: DX = 2.)
INSIDE	Index of finest nest actually used for computations; the finest active grid spacing is DX*2**(INSIDE-1) (default: INSIDE = 1)
HOLL	Power to which radius is raised in the modified Holland's (1980) pressure profile model. When HOLL(2) = 0., only one exponential is used; RADIUS(2) and DPRESS(2) are then ignored.
B1,B2	Alternate names for specifying HOLL; convenient when only one exponential is modeled. Default values are B1 = 1., B2 = 0. These defaults are reinstated for every snapshot. Use of the defaults reverts to a standard exponential pressure profile, as used in SNAP_ADC.7NE.
DPRESS	DPRESS(I) is the pressure difference associated with RADIUS(I) and HOLL(I) in OWI's double-eyewall extension of Holland's (1980) modified exponential profile.
DP1,DP2	Alternate names for specifying DPRESS. As explained in the part on Mathematical Method, it is never advantageous to include DP2 in an input list; it is in the NAMELIST in order to force its appearance in the output file.

SPECIAL WARNING: Do not input both members of an equivalence. Input either RADIUS or RAD and RAD2; either HOLL or B1 and B2; either DPRESS or DP1 and DP2. The program imposes consistency checks on RADIUS, HOLL, and DPRESS; it does not check EYPRES and PFAR, so that it remains the user's duty to verify that PFAR > EYPRES.

Mathematical method

The program performs the following consistency checks:

1. If B1 < 0 or B2 < 0, stop.

2. If B2 = 0, run Holland's modified exponential model (ignore RAD2 and DP2).

   2.1 If RAD1 ≤ 0, stop.
   2.2 If DP1 not specified, compute it as PFAR-EYPRES.
   2.3 If DP1 specified, but inconsistent with PFAR-EYPRES, stop.
   2.4 Set N = 1.

3. If B2 > 0, run OWI's extension of Holland's pressure profile.

   3.1 If RAD1 ≤ 0 or RAD2 ≤ 0, stop.
   3.2 If DP2 not specified, compute it as PFAR-EYPRES-DP1.
   3.3 If DP2 specified, but inconsistent with PFAR-EYPRES-DP1, stop.
   3.4 Set N = 2.

Program 1EYEWALL.HOL

Program 1EYEWALL.HOL attempts to fit snapshot parameters to a guessed wind profile. It considers only the case of one exponential (B2 = 0.0). 1EYEWALL.HOL requires the following input arguments (in namelist /INN/):

BLAT	Absolute value of latitude of eye, degrees & decimals; used in computation of the Coriolis parameter. Also, the value BLAT=99 is used as a flag to stop computation.
EYPRES	Pressure at eye, in mb
PFAR	Pressure at large (theoretically infinite) distance from eye, in mb
RW1	Radius at which a wind speed is guessed, in km
SP1	Wind speed corresponding to RW1, in m/sec
V150	Wind speed at radius of 150 km, in m/sec

The following outputs are printed:

1. In namelist /INN/:

   SP11, SP12 = SP1 minus & plus 1 m/sec
   SP31, SP32 = V150 minus & plus 1 m/sec
   DP2 = pressure difference (far field minus eye), in pascal

2. In namelist /VORTEX/:

   COR = Coriolis parameter, 2*omega*sin(BLAT)

FR22 = the quantity 0.5*COR*RW1 (used in the computation of gradient wind)
FR23 = 0.5*COR*r, where r is 150000 m or 150 km
PEYE = pressure at eye, in pascal

3. Below namelist /VORTEX/, six parameters are printed, defined from left to right as:

3.1 DP2 (see above)
3.2 Fitted value of scale radius, in m
3.3 Fitted value of Holland's exponent
3.4 Fitted value of gradient wind at radius RW1, in m/sec (in a good fit, this will be nearly equal to SP1)
3.5 Fitted value of gradient wind at radius 150 km, in m/sec (in a good fit, this will be nearly equal to V150)
3.6 Goodness of fit measure: absolute value of gradient wind minus in put wind at radius RW1, plus the same at radius 150 km. A value less than 3.0 implies a tolerably well-fitting solution.

4. Table with 6 columns and 150 lines:

4.1 Radius, in km
4.2 Pressure, in mb
4.3 First component of pressure gradient, in pascal/m
4.4 Second component (this is zero, since only one exponential was fitted)
4.5 Pressure gradient (here equal to output #4.3)
4.6 Gradient wind, m/sec

5. Below the table are numbers that, if the fit is satisfactory, the user can insert into namelist /NAME3/ of SNAP_HOL.7NE:

EYELAT = echo of the input BLAT
EYPRES = echo of input
PFAR = echo of input
RAD1 = scale radius, in nm
HOLL = two values of Holland's exponent; the second value is zero, because only one exponential was fitted

Program 2EYEWALL.HOL

Program 2EYEWALL.HOL attempts to fit snapshot parameters to a guessed wind profile. It considers the case of two exponentials (B2 > 0.0). 2EYEWALL.HOL requires the following inputs in namelist /INN/:

BLAT	Same usage as in 1EYEWALL.HOL
EYPRES	Same usage as in 1EYEWALL.HOL
PFAR	Same usage as in 1EYEWALL.HOL

RS1 Scale radius of inner ring, in km
(numerical experiments with this scheme have shown that the inner scale radius can safely be taken equal to the inner radius to local maximum wind)

RW2 Radius to maximum wind of outer ring, in km

DRING An integer switch variable indexing the shape of the wind profile

DRING = 1: the maximum wind is greater in the inner ring
DRING = 2: the maximum wind is greater in the outer ring

SP1 Desired wind speed at radius RS1, in m/sec

SP2 Desired wind speed at radius RW2, in m/sec

The following outputs are printed:

1. In namelist /INN/:

SP11, SP12 = SP1 minus and plus 1 m/sec
SP21, SP22 = SP2 minus and plus 1 m/sec

2. In namelist /VORTEX/:

BLAT = echo of input
COR = same usage as in 1EYEWALL.HOL
RAD1 = RS1, in m
RAD2 = RW2, in m
RAD3 = 0.5*(RAD1+RAD2); a local minimum of wind speed, if found, will be near RAD3
RAD4 = 150000 m (= 150 km)
FR21 = the quantity 0.5*COR*RAD1; used in the computation of gradient wind
FR22 = the quantity 0.5*COR*RAD2
FR23 = the quantity 0.5*COR*RAD3
PEYE = same usage as in 1EYEWALL.HOL
DP = pressure difference (far field minus eye), in pascal

3. Below namelist /VORTEX/, nine parameters are printed, defined from left to right as:

3.1 Fitted value of DP1 (partial pressure difference for first exponential), in pascal
3.2 Fitted value of DP2 (partial pressure difference for second exponential), in pascal
3.3 Scale radius of second exponential, in m (the scale radius of first exponential has been fixed at RAD1)
3.4 Exponent for first exponential (Holland 1980)
3.5 Exponent for second exponential (OWI extension of Holland (1980))
3.6 Fitted wind speed at radius RAD1, m/sec
3.7 Fitted wind speed at radius RAD2, m/sec

3.8 Fitted wind speed at radius RAD3, m/sec
3.9 (printed below 3.1): fitted wind speed at radius 150 km

4. Second printing of namelist /INN/, if given:

The fit in the above two-line summary was unsatisfactory in that the wind at 150 km was greater than the wind at RAD2; a second fit will be attempted, this time minimizing the wind speed at 150 km.

SP11, SP12 = SP1 minus and plus 2 m/sec
SP21, SP22 = SP2 minus and plus 2 m/sec

5. Below second printing of /INN/: the same nine parameters as in #3 above, for the second attempted fit.

6. Table with 6 columns and 150 lines:

6.1 Radius, in km
6.2 Pressure, in mb
6.3 First component of pressure gradient, in pascal/m
6.4 Second component of pressure gradient, in pascal/m
6.5 Pressure gradient (sum of the two components), in pascal/m
6.6 Gradient wind, in m/sec

7. Below the table are numbers that, if the fit is satisfactory, the user can insert into namelist /NAME3/ of SNAP_HOL.7NE:

EYELAT = echo of the input BLAT
EYPRES = echo of input
PFAR = echo of input
RADIUS = two values of scale radius, in nm
HOLL = two values of Holland's exponent
DP1 = pressure difference for first component, in mb
(program SNAP_HOL.7NE computes DP2 by subtraction)

Appendix C Sample Application of Upgraded CE Model to Simulation of 12 Snapshots of Hurricane Gilbert

This appendix provides input file information used by OWI in test runs with the upgraded CE model, including seven nests and the generalized pressure specification. Snapshots were generated at 6-hr intervals for Hurricane Gilbert, which occurred during September 1988. The first snapshot represents 1200 UTC (Universal Time Coordinate, formerly known as Greenwich Mean Time) 15 September 1988. In all, 12 snapshots were generated. Inputs for the programs SNAP_HOL.7NE and HIST_ADC.7NE are included as implemented on the OWI VAX computer. The listed values of parameter AN1 follow a meteorological convention (deg azimuth coming from) rather than the convention used by the Cardone et al. (1992).

Listings of the full field of surface (19-m elevation) wind speed and direction were generated on a polar output grid. They are included here at 6-hr intervals (snapshot times). Wind speed is in m/sec. Wind direction is in deg azimuth coming from. Printed output of the azimuthally averaged, surface wind speed and inflow angle is also given in this appendix. In addition to the 12 snapshot wind fields, this output includes a wind field interpolated halfway betwee each pair of snapshots.

```
$ ASSIGN GRID.312      FOR012
$ ASSIGN 05GILBERT21   FOR005
$ ASSIGN GILB.WIND21   FOR052
$ RUN HOLL3
$NAME1
KZM      =        8309,
KDM      =      151200,
KMIN     =         180,
DX       =    2.000030     ,
KSTRES   =           0,
NSTRES   =       17227,
KWIND    =          19,
NWIND    =         312,
HM       =    500.0030     ,
INSIDE   =           1,
KTIME    =           1
$END
$NAME2
EYELAT   =    16.00030     ,
DIREC    =    290.0030     ,                  Snapshot 1
SPEED    =    11.00030     ,
EYPRES   =    972.0030     ,
PFAR     =    1011.030     ,
RAD1     =    25.38030     ,
RAD2     =    68.73030     ,
RADIUS   =    25.38030     ,   68.73000    ,
DP1      =    22.85030     ,
DP2      =    16.15030     ,
DPRES    =    22.85030     ,   16.15000    ,
B1       =    2.520030     ,
B2       =    2.520030     ,
HOLL     =  2*2.520030
SGW      =    7.000030     ,
AN1      =    110.0030     ,
ST12     =  0.0000030E+00
$END
$NAME2
EYELAT   =    16.00030     ,
DIREC    =    290.0030     ,                  Snapshot 2
SPEED    =    11.00030     ,
EYPRES   =    968.0030     ,
PFAR     =    1011.030     ,
RAD1     =    31.32030     ,
RAD2     =    87.37030     ,
RADIUS   =    31.32030     ,   87.37000    ,
DP1      =    31.77030     ,
DP2      =    11.23030     ,
DPRES    =    31.77030     ,   11.23000    ,
B1       =    2.520030     ,
B2       =    2.520030     ,
HOLL     =  2*2.520030     ,
SGW      =    7.000030     ,
AN1      =    110.0030     ,
ST12     =  0.0000030E+00
$END
```

Figure C1. Program inputs, Hurricane Gilbert (Sheet 1 of 6)

```
$NAME2
EYELAT  =   19.00000     ,
DIREC   =   290.0000     ,
SPEED   =   11.00000     ,
EYPRES  =   905.0000     ,
PFAR    =   1012.000     ,
RAD1    =   8.640000     ,
RAD2    =   67.28000     ,
RADIUS  =   8.640000     ,   67.28000     ,
DP1     =   93.83000     ,
DP2     =   13.17000     ,
DPRES   =   93.83000     ,   13.17000     ,
B1      =   1.680000     ,
B2      =   2.380000     ,
HOLL    =   1.680000     ,   2.380000     ,
SGW     =   7.000000     ,
AN1     =   110.0000     ,
ST12    =   0.0000000E+00
$END
```

Snapshot 3

```
$NAME2
EYELAT  =   20.00000     ,
DIREC   =   290.0000     ,
SPEED   =   11.00000     ,
EYPRES  =   888.0000     ,
PFAR    =   1012.000     ,
RAD1    =   7.020000     ,
RAD2    =   54.00000     ,
RADIUS  =   7.020000     ,   54.00000     ,
DP1     =   110.2200     ,
DP2     =   13.78000     ,
DPRES   =   110.2200     ,   13.78000     ,
B1      =   1.590000     ,
B2      =   2.520000     ,
HOLL    =   1.590000     ,   2.520000     ,
SGW     =   7.000000     ,
AN1     =   110.0000     ,
ST12    =   0.0000000E+00
$END
```

Snapshot 4

```
$NAME2
EYELAT  =   20.00000     ,
DIREC   =   290.0000     ,
SPEED   =   11.00000     ,
EYPRES  =   893.0000     ,
PFAR    =   1012.000     ,
RAD1    =   7.020000     ,
RAD2    =   37.80000     ,
RADIUS  =   7.020000     ,   37.80000     ,
DP1     =   101.1200     ,
DP2     =   17.88000     ,
DPRES   =   101.1200     ,   17.88000     ,
B1      =   1.410000     ,
B2      =   2.520000     ,
HOLL    =   1.410000     ,   2.520000     ,
SGW     =   7.000000     ,
AN1     =   110.0000     ,
ST12    =   0.0000000E+00
$END
```

Snapshot 5

Figure C1. (Sheet 2 of 6)

Snapshot 6

```
$NAME2
EYELAT  =    21.00000     ,
DIREC   =    290.0000     ,
SPEED   =    11.00000     ,
EYPRES  =    890.0000     ,
PFAR    =    1012.000     ,
RAD1    =    7.020000     ,
RAD2    =    37.26000     ,
RADIUS  =    7.020000     ,   37.26000     ,
DP1     =    101.8000     ,
DP2     =    20.20000     ,
DPRES   =    101.8000     ,   20.20000     ,
B1      =    1.410000     ,
B2      =    2.520000     ,
HOLL    =    1.410000     ,   2.520000     ,
SGW     =    7.000000     ,
AN1     =    110.0000     ,
ST12    =  0.0000000E+00
$END
```

Snapshot 7

```
$NAME2
EYELAT  =    22.00000     ,
DIREC   =    290.0000     ,
SPEED   =    11.00000     ,
EYPRES  =    951.0000     ,
PFAR    =    1012.000     ,
RAD1    =    11.88000     ,
RAD2    =    46.85000     ,
RADIUS  =    11.88000     ,   46.85000     ,
DP1     =    45.07000     ,
DP2     =    15.93000     ,
DPRES   =    45.07000     ,   15.93000     ,
B1      =  0.5600000      ,
B2      =    2.520000     ,
HOLL    =  0.5600000      ,   2.520000     ,
SGW     =    7.000000     ,
AN1     =    110.0000     ,
ST12    =  0.0000000E+00
$END
```

Snapshot 8

```
$NAME2
EYELAT  =    22.00000     ,
DIREC   =    290.0000     ,
SPEED   =    11.00000     ,
EYPRES  =    950.0000     ,
PFAR    =    1012.000     ,
RAD1    =    17.28000     ,
RAD2    =    55.82000     ,
RADIUS  =    17.28000     ,   55.82000     ,
DP1     =    34.57000     ,
DP2     =    27.43000     ,
DPRES   =    34.57000     ,   27.43000     ,
B1      =  0.9400000      ,
B2      =    2.520000     ,
HOLL    =  0.9400000      ,   2.520000     ,
SGW     =    7.000000     ,
AN1     =    110.0000     ,
ST12    =  0.0000000E+00
$END
```

Figure C1. (Sheet 3 of 6)

```
$NAME2
EYELAT  =   23.00030     ,
DIREC   =   290.0030     ,               Snapshot 9
SPEED   =   11.00030     ,
EYPRES  =   949.0030     ,
PFAR    =   1010.030     ,
RAD1    =   11.88030     ,
RAD2    =   43.53030     ,
RADIUS  =   11.88030     ,   43.53000     ,
DP1     =   40.67030     ,
DP2     =   20.33030     ,
DPRES   =   40.67030     ,   20.33000     ,
B1      =  0.7500030     ,
B2      =   2.520030     ,
HOLL    =  0.7500030     ,   2.520000     ,
SGW     =   7.000030     ,
AN1     =   110.0030     ,
ST12    =  0.0000030E+00
$END
$NAME2
EYELAT  =   23.00030     ,
DIREC   =   290.0030     ,               Snapshot 10
SPEED   =   11.00030     ,
EYPRES  =   950.0030     ,
PFAR    =   1011.030     ,
RAD1    =   29.70030     ,
RAD2    =   91.63030     ,
RADIUS  =   29.70030     ,   91.63000     ,
DP1     =   51.84030     ,
DP2     =   9.160030     ,
DPRES   =   51.84030     ,   9.160000     ,
B1      =   1.120030     ,
B2      =   2.240030     ,
HOLL    =   1.120030     ,   2.240000     ,
SGW     =   7.000030     ,
AN1     =   110.0030     ,
ST12    =  0.0000030E+00
$END
$NAME2
EYELAT  =   24.00030     ,
DIREC   =   290.0030     ,               Snapshot 11
SPEED   =   11.00030     ,
EYPRES  =   953.0030     ,
PFAR    =   1010.030     ,
RAD1    =   27.00030     ,
RAD2    =   64.21030     ,
RADIUS  =   27.00030     ,   64.21000     ,
DP1     =   46.62030     ,
DP2     =   10.38030     ,
DPRES   =   46.62030     ,   10.38000     ,
B1      =   1.330030     ,
B2      =   2.520030     ,
HOLL    =   1.330030     ,   2.520000     ,
SGW     =   7.000030     ,
AN1     =   110.0030     ,
ST12    =  0.0000030E+00
$END
```

Figure C1. (Sheet 4 of 6)

Snapshot 12

```
$NAME2
EYELAT  =    24.00000     ,
DIREC   =    290.0000     ,
SPEED   =    11.00000     ,
EYPRES  =    954.0000     ,
PFAR    =    1009.000     ,
RAD1    =    21.60000     ,
RAD2    =    60.61000     ,
RADIUS  =    21.60000     ,  60.61000     ,
DP1     =    44.98000     ,
DP2     =    10.02000     ,
DPRES   =    44.98000     ,  10.02000     ,
B1      =    1.190000     ,
B2      =    2.520000     ,
HOLL    =    1.190000     ,  2.520000     ,
SGW     =    7.000000     ,
AN1     =    110.0000     ,
ST12    =  0.0000000E+00
$END
$NAME2
EYELAT  =    999.0000     ,
DIREC   =    290.0000     ,
SPEED   =    11.00000     ,
EYPRES  =    954.0000     ,
PFAR    =    1009.000     ,
RAD1    =  0.0000000E+00,
RAD2    =  0.0000000E+00,
RADIUS  = 2*0.0000000E+00,
DP1     =  0.0000000E+00,
DP2     =  0.0000000E+00,
DPRES   = 2*0.0000000E+00,
B1      =    1.000000     ,
B2      =  0.0000000E+00,
HOLL    =    1.000000     , 0.0000000E+00,
SGW     =    7.000000     ,
AN1     =    110.0000     ,
ST12    =  0.0000000E+00
$END
```

```
  0  20   0   0   0   1   0
  2  20   0   0   0   2   0
  4  20   0   0   0   3   0
  6  20   0   0   0   4   0
  8  20   0   0   0   5   0
 10  20   0   0   0   6   0
 12  20   0   0   0   7   0
 14  20   0   0   0   8   0
 16  20   0   0   0   9   0
 18  20   0   0   0  10   0
 20  20   0   0   0  11   0
 22  20   0   0   0  12   0
999   0   0   0   0   0   0
```

Figure C1. (Sheet 5 of 6)

```
                              STORM HISTORY   ZERO HOUR IS     8809 151200
HOUR       LAT      LONG      SNAPS     INTERP  ROT


   0    20     0     0    0     1    0   0.0000    0
   1    20     0     0    0     1    2   0.5000    0
   2    20     0     0    0     2    0   0.0000    0
   3    20     0     0    0     2    3   0.5000    0
   4    20     0     0    0     3    0   0.0000    0
   5    20     0     0    0     3    4   0.5000    0
   6    20     0     0    0     4    0   0.0000    0
   7    20     0     0    0     4    5   0.5000    0
   8    20     0     0    0     5    0   0.0000    0
   9    20     0     0    0     5    6   0.5000    0
  10    20     0     0    0     6    0   0.0000    0
  11    20     0     0    0     6    7   0.5000    0
  12    20     0     0    0     7    0   0.0000    0
  13    20     0     0    0     7    8   0.5000    0
  14    20     0     0    0     8    0   0.0000    0
  15    20     0     0    0     8    9   0.5000    0
  16    20     0     0    0     9    0   0.0000    0
  17    20     0     0    0     9   10   0.5000    0
  18    20     0     0    0    10    0   0.0000    0
  19    20     0     0    0    10   11   0.5000    0
  20    20     0     0    0    11    0   0.0000    0
  21    20     0     0    0    11   12   0.5000    0
  22    20     0     0    0    12    0   0.0000    0
$WHAT
KSTEP2  =           22
$END
 WORKK:              0          8809        151200
 WORKK:              1          8809        151500
 WORKK:              2          8809        151800
 WORKK:              3          8809        152100
 WORKK:              4          8809        160000
 WORKK:              5          8809        160300
 WORKK:              6          8809        160600
 WORKK:              7          8809        160900
 WORKK:              8          8809        161200
 WORKK:              9          8809        161500
 WORKK:             10          8809        161800
 WORKK:             11          8809        162100
 WORKK:             12          8809        170000
 WORKK:             13          8809        170300
 WORKK:             14          8809        170600
 WORKK:             15          8809        170900
 WORKK:             16          8809        171200
 WORKK:             17          8809        171500
 WORKK:             18          8809        171800
 WORKK:             19          8809        172100
 WORKK:             20          8809        180000
 WORKK:             21          8809        180300
 WORKK:             22          8809        180600
END OF STRESS RUN
```

Figure C1. (Sheet 6 of 6)

Azimuth (deg)

Radius from Eye (km)

HOUR 0	0.	30.	60.	90.	120.	150.	180.	210.	240.	270.	300.	330.	
1.85	5.9196 98.6093	5.9045 98.4339	5.8998 98.0925	5.9068 97.6786	5.9242 97.3422	5.9450 97.1356	5.9535 97.1127	5.9752 97.2932	5.9781 97.6151	5.9717 97.9934	5.9587 98.3642	5.9396 98.5902	Speed Direction
3.70	5.9053 99.4865	5.8707 99.1123	5.8574 98.3941	5.8731 97.5705	5.9104 96.8860	5.9547 96.4938	5.9306 96.4569	6.0111 96.8079	6.0155 97.4243	6.0055 98.1888	5.9828 98.9262	5.9474 99.4206	
5.56	5.8987 100.4693	5.8381 99.8900	5.8130 98.7797	5.8369 97.5117	5.8975 96.4843	5.9668 95.9071	6.0199 95.8765	6.0471 96.3707	6.0531 97.2723	6.0429 98.4071	6.0169 99.5472	5.9667 100.3353	
7.41	5.9043 101.5862	5.8081 100.7703	5.7649 99.2399	5.7964 97.5273	5.8836 96.1222	5.9812 95.3598	6.0509 95.3351	6.0829 95.9684	6.0908 97.1365	6.0868 98.6466	6.0631 100.1960	6.0009 101.3348	
9.26	5.9283 102.8765	5.7813 101.8027	5.7133 99.8451	5.7486 97.6652	5.8676 95.8229	5.9962 94.8614	6.0831 94.8378	6.1189 95.6022	6.1304 97.0233	6.1428 98.8963	6.1333 100.9027	6.0610 102.4407	
11.11	5.9882 104.4123	5.7649 103.0760	5.6561 100.6987	5.6882 98.0189	5.8429 95.6352	6.0117 94.4094	6.1163 94.3301	6.1550 95.2711	6.1807 96.8747	6.2273 99.0752	6.2529 101.6151	6.1741 103.7215	
12.96	6.1286 106.3336	5.7660 104.7010	5.5923 101.9891	5.6034 98.8317	5.8023 95.6556	6.0255 94.0073	6.1500 93.9380	6.1925 94.9563	6.2732 96.3072	6.4122 98.5138	6.5045 102.1071	6.4462 105.0828	
14.82	6.5015 108.7335	5.8091 106.9004	5.5234 104.1677	5.4666 100.9022	5.7212 96.2656	6.0349 93.6860	6.1339 93.5750	6.2316 94.6458	6.4952 93.6712	6.9504 93.9747	7.1461 101.0636	7.1547 105.6850	
16.67	7.5463 111.1102	5.9973 110.2957	5.4917 109.0356	5.2338 107.7331	5.5279 98.9748	5.9943 93.9497	6.1598 93.3360	6.2647 94.2947	7.0274 85.6591	8.5797 79.3535	8.7210 95.6300	8.9364 102.8374	
18.52	9.8565 110.9075	6.6193 115.8243	5.8063 120.7771	5.2179 128.3313	5.0923 108.6514	5.6780 97.0376	5.6764 93.0520	6.2315 93.6413	8.4014 69.3796	12.2251 55.4717	11.5958 84.2490	12.0818 94.4100	
27.78	32.8573 82.0297	24.3052 120.4944	21.3874 146.6917	18.7590 173.5462	15.5180 203.1869	11.9573 242.9128	11.5172 301.6315	21.4211 335.9307	34.7541 346.4803	41.4234 0.4788	44.2547 18.8326	42.3971 44.0079	
37.04	46.2677 56.4293	40.0264 100.7916	33.2342 139.7525	29.2763 173.0478	27.3211 208.9543	26.8795 245.3624	32.0566 280.0329	40.2791 300.2534	43.2172 319.3888	44.8667 341.3094	46.8943 2.3831	47.3146 26.6587	
46.30	45.9567 48.6297	43.5502 84.0974	37.4322 130.6747	33.4423 171.3562	32.9490 207.4249	34.1627 238.1564	37.0584 265.6593	39.7871 287.9271	41.2559 311.1664	42.8003 335.1673	44.4086 357.8099	45.2970 21.6510	
55.56	43.9233 45.2185	43.2629 76.7872	39.0072 119.8570	35.5084 165.6430	34.6832 201.1010	35.3037 231.5239	36.7684 258.2351	37.8654 282.5763	38.9099 307.4648	40.4307 332.0189	41.9051 355.7097	42.8609 19.6294	
74.08	40.2472 41.8043	40.5314 70.3809	39.2017 104.4480	36.5206 146.0135	35.2295 183.3792	33.9128 216.6584	33.8253 247.5486	34.7682 274.8717	35.2842 301.6903	36.6578 327.5295	38.1559 352.6945	39.2619 16.7851	
92.60	37.6369 39.8793	37.9756 67.2837	37.6074 98.0080	35.7160 135.4094	33.8160 172.1577	32.3110 206.3064	31.7723 239.5470	31.9663 269.1052	32.5335 297.4193	33.9076 324.5133	35.1707 350.6434	36.5348 14.9308	
111.12	34.8055 39.3475	35.2379 65.9315	35.0755 95.6080	33.7196 130.0881	31.6906 166.8306	30.0568 201.3219	29.3595 235.0364	29.1312 266.5547	29.6297 296.0707	30.9557 323.5601	32.1910 350.3058	33.6129 14.9512	
138.90	30.2493 40.7342	30.7611 66.4468	30.7645 94.3633	29.4682 127.0138	27.5210 163.9196	25.7919 198.5079	24.7762 233.3592	24.5025 267.3182	24.9651 297.5834	26.2332 325.6798	27.6136 352.8550	29.0277 16.9328	
166.68	26.2961 43.2022	26.6758 67.7149	26.7038 94.7039	25.5612 125.9559	23.4829 162.2868	21.6182 198.2842	20.5507 234.4804	20.1863 270.1249	20.7486 301.8985	22.1489 329.9905	23.5127 356.8000	24.9486 20.5199	

Figure C2. Wind speed and direction fields, Snapshot 1, Hurricane Gilbert (Continued)

Radius from Eye (km)	Azimuth (deg)												
222.24	20.1763	20.5489	20.5155	19.3596	17.2306	15.1857	13.9339	13.7449	14.6816	16.1443	17.6215	19.0218	Speed
	49.9154	71.7559	96.4103	125.4406	160.8909	200.0019	241.7430	281.1733	315.5402	343.5226	7.7929	29.6800	Direction
333.36	13.9754	14.1202	13.9180	12.9230	10.6129	7.6873	5.5320	6.5855	8.9031	10.7288	12.0565	13.1830	
	62.6214	79.9179	99.1703	122.5205	154.4728	196.1169	257.0366	320.8015	353.3109	14.0094	32.8963	48.2193	
444.48	11.0553	11.2204	10.9171	9.0243	7.6857	3.9880	0.3384	4.2311	6.9803	8.8028	9.8552	10.6034	
	73.3255	85.0249	98.9748	115.6985	136.8337	159.7079	36.1353	23.2502	33.5358	43.7375	53.3203	63.1288	
666.72	8.8753	8.8489	8.5889	7.8842	6.8355	5.7000	5.2495	6.0444	6.9774	7.6675	8.1685	8.5773	
	84.1473	89.4718	95.3434	101.6790	105.4992	103.8498	91.4645	80.0717	74.9345	74.3790	76.8099	80.1545	
888.96	7.9807	7.9934	7.8699	7.5800	7.1685	6.7650	6.6496	6.8371	7.1830	7.4622	7.7034	7.8860	
	88.3425	90.3910	92.9293	95.1161	96.2502	95.2139	91.9270	87.8430	85.2615	84.6539	84.9862	86.3313	
1111.20	7.6147	7.6701	7.6289	7.4534	7.3143	7.1497	7.0760	7.1471	7.2871	7.4080	7.5560	7.6142	
	91.5157	91.1940	91.8595	93.8632	93.4163	92.7961	91.4283	89.5882	88.4036	88.3303	87.9437	89.2628	
1333.44	0.0003	7.4508	7.4772	0.0000	7.2797	7.2878	0.0300	7.2796	7.2792	0.0000	7.4731	7.4236	
	0.0003	93.3572	92.5252	0.0000	93.8222	91.7959	0.0300	90.2046	90.7734	0.0000	89.6800	92.3308	

Figure C2. (Concluded)

HOUR 2		0.	30.	60.	90.	120.	150.	180.	210.	240.	270.	300.	330.
1.85	Speed	5.9633	5.9520	5.9504	5.9598	5.9777	5.9975	6.0138	6.0233	6.0239	6.0157	6.0016	5.9827
	Direction	97.8063	97.6120	97.2786	96.8966	96.5998	96.4341	96.4425	96.6329	96.9469	97.3017	97.6331	97.8183
3.70	Speed	5.9453	5.9171	5.9119	5.9326	5.9705	6.0115	6.0428	6.0590	6.0597	6.0464	6.0211	5.9848
	Direction	98.5973	98.1840	97.4789	96.7213	96.1267	95.8205	95.8498	96.2098	96.8114	97.5298	98.1938	98.6028
5.56	Speed	5.9322	5.8831	5.8724	5.9050	5.9653	6.0282	6.0737	6.0949	6.0957	6.0805	6.0498	5.9970
	Direction	99.4753	98.8245	97.7274	96.5696	95.6958	95.2550	95.3361	95.8249	96.7057	97.7747	98.8057	99.4607
7.41	Speed	5.9273	5.8501	5.8306	5.8758	5.9607	6.0472	6.1359	6.1303	6.1316	6.1200	6.0891	6.0218
	Direction	100.4615	99.5362	98.0046	96.4519	95.2924	94.7278	94.8362	95.4686	96.6097	98.0362	99.4424	100.3925
9.26	Speed	5.9363	5.8188	5.7871	5.8434	5.9556	6.0672	6.1392	6.1658	6.1684	6.1681	6.1473	6.0672
	Direction	101.5811	100.3409	98.3463	96.3884	94.9333	94.2433	94.3459	95.1421	96.5329	98.3086	100.1290	101.4139
11.11	Speed	5.9654	5.7923	5.7397	5.8048	5.9467	6.0882	6.1733	6.2011	6.2114	6.2342	6.2398	6.1514
	Direction	102.8771	101.2927	98.7786	96.4175	94.6372	93.8016	93.9214	94.8462	96.4433	98.5499	100.8346	102.5744
12.96	Speed	6.0325	5.7719	5.6878	5.7552	5.9313	6.1086	6.2388	6.2370	6.2792	6.3636	6.4063	6.3243
	Direction	104.4223	102.4176	99.3627	96.6139	94.4258	93.3988	93.5296	94.5682	96.1548	98.3872	101.4874	103.8504
14.82	Speed	6.1972	5.7624	5.6294	5.6857	5.9040	6.1281	6.2430	6.2737	6.4276	6.7339	6.7647	6.7389
	Direction	106.3715	103.7812	100.1962	97.1333	94.3417	93.0328	93.1585	94.3009	94.8383	95.6924	101.5828	104.9185
16.67	Speed	6.6501	5.7737	5.5629	5.5761	5.8539	6.1453	6.2783	6.3142	6.7708	7.8700	7.6364	7.7757
	Direction	108.8111	105.5087	101.4775	98.3632	94.4765	92.7067	92.8348	94.0076	90.4646	85.2237	99.4146	104.3421
18.52	Speed	7.8853	5.8289	5.4905	5.3775	5.7604	6.1570	6.3314	6.3636	7.5809	10.7285	9.5238	9.9542
	Direction	110.8739	107.8401	103.6595	101.5091	95.0400	92.4389	92.5102	93.5831	80.4667	64.3699	92.6671	99.5503
27.78	Speed	26.8754	15.7405	12.5369	9.8057	6.7697	2.8472	3.2671	14.9049	30.6683	39.8221	42.6345	39.6113
	Direction	89.3194	127.2386	149.1053	171.5016	196.3009	225.8244	19.7336	359.4360	357.2520	6.7549	24.1872	50.0346
37.04	Speed	48.0277	41.2113	32.6583	27.1963	25.8830	24.9353	28.2568	41.0915	45.6548	47.3736	49.8554	49.9335
	Direction	57.7753	102.4577	142.0267	175.3557	211.2692	243.4606	281.3641	301.5291	319.2315	341.1176	1.6943	26.6466
46.30	Speed	49.8413	48.0112	43.0615	38.5967	38.6665	39.1754	40.2656	44.0577	45.3157	46.7354	48.4355	49.4028
	Direction	47.1331	82.4610	125.7951	155.2495	199.8044	229.3318	259.1231	282.2884	306.5641	331.4635	354.9141	19.3319
55.56	Speed	48.0513	47.3375	44.2973	41.6640	40.7925	40.5947	41.1214	42.1166	43.0315	44.5568	45.8580	46.9883
	Direction	43.2573	75.3721	115.6600	157.0487	190.8022	221.5014	250.4762	276.3683	302.3271	327.5806	352.4450	16.9811
74.08	Speed	42.4392	42.3529	40.9433	38.7025	37.2324	36.1754	36.1115	36.6904	37.3884	38.8198	40.1013	41.2890
	Direction	41.7037	71.2547	106.0334	146.1272	182.8858	215.1541	245.6175	273.9910	300.7360	326.4543	352.1574	16.4346
92.60	Speed	38.2892	38.3317	37.6405	35.7809	33.6876	32.4099	32.2264	32.4140	33.1382	34.6455	35.8155	37.0893
	Direction	41.3911	69.4842	101.2390	139.5944	176.6640	210.6687	243.0122	272.2526	299.9973	326.4628	352.3108	16.4527
111.12	Speed	35.1776	35.4379	35.0255	33.4980	31.4084	29.8380	29.3367	29.4569	30.0429	31.4681	32.7217	34.0181
	Direction	41.1493	68.2122	98.6283	134.4621	171.6859	206.4824	239.9527	270.5181	299.3256	326.2336	352.3690	16.7416
138.90	Speed	31.2913	31.7120	31.5796	30.1308	28.1733	26.4572	25.6350	25.6106	26.1244	27.4348	28.8266	30.1456
	Direction	41.5964	67.7603	96.2377	129.8442	167.1044	201.9287	236.6561	269.6312	299.2667	326.8849	353.5935	17.6037
166.68	Speed	27.8273	28.1971	28.1478	26.8397	24.8534	23.0127	22.0351	21.8949	22.4529	23.8230	25.2144	26.5792
	Direction	43.1142	68.1302	95.7161	127.8130	164.2305	200.1419	236.1360	270.4874	301.5839	329.5018	355.9854	19.9009

Azimuth (deg)

Radius from Eye (km)

Figure C3. Wind speed and direction fields, Snapshot 2, Hurricane Gilbert (Continued)

Azimuth (deg)

Radius from Eye (km)													
222.24	21.9911	22.3232	22.2726	21.0870	18.9781	17.0186	15.0322	15.6539	16.5320	17.9669	19.4286	20.8117	Speed
	48.2227	71.0506	96.5934	126.4082	161.9759	200.1871	240.1353	277.7679	311.2652	339.4258	4.3871	26.9669	Direction
333.36	15.2757	15.4210	15.2246	14.1769	11.9390	9.4886	7.6965	8.2934	10.0545	11.8255	13.1758	14.3636	
	59.4005	78.2312	99.0086	124.0854	157.5215	198.7374	252.5386	307.8060	341.9530	5.4697	26.3856	43.4537	
444.48	11.9073	12.0923	11.7786	10.6246	8.5293	4.7203	1.5528	4.3999	7.3629	9.3391	10.5166	11.4103	
	70.2153	83.7145	99.6362	118.9123	143.9636	177.7417	270.7507	359.5338	20.2696	34.2230	46.4090	58.2868	
666.72	9.2662	9.2394	8.9672	8.1158	6.7512	5.2103	4.5113	5.6274	6.9053	7.8189	8.4626	8.9583	
	82.2225	89.0190	96.5086	104.9461	110.9293	109.6753	91.1332	75.0665	69.0070	69.1428	72.6525	77.0961	
888.96	8.1847	8.2004	8.0345	7.6305	7.0729	6.5155	6.3550	6.6315	7.1698	7.4900	7.8129	8.0559	
	87.4849	90.2799	93.6934	96.6363	98.3175	97.0027	92.4366	86.6739	83.1636	82.4594	83.0121	84.8488	
1111.20	7.7192	7.7726	7.7063	7.4752	7.2659	7.0368	6.9530	7.0419	7.2372	7.4105	7.6052	7.6954	
	91.0993	91.1649	92.2911	94.6550	94.3952	93.6327	91.7308	89.2000	87.5509	87.3217	86.9743	88.5360	
1333.44	0.0003	7.5087	7.5175	0.0000	7.2566	7.2337	0.0000	7.2227	7.2460	0.0003	7.4986	7.4720	
	0.0003	93.3492	92.7996	0.0000	94.3413	92.2635	0.0000	90.0509	90.3996	0.0000	89.1563	91.9366	

Figure C3. (Concluded)

Radius from Eye (km)

Azimuth (deg)

HOUR 4	0.	30.	60.	90.	120.	150.	180.	210.	240.	270.	300.	330.	
1.85	6.3963 120.1605	6.0342 127.8085	5.3757 129.2227	4.5752 121.4585	4.1147 114.8558	4.3837 105.6827	5.3363 99.5386	5.9529 95.3092	6.4900 97.1922	6.8297 103.5944	7.3454 108.2067	7.1832 113.7208	Speed Direction
3.70	10.6923 124.7703	10.4571 139.6135	9.3294 159.5219	6.5165 175.0289	3.9818 187.1803	0.3307 159.2131	3.4118 59.7516	5.8609 57.5497	8.8824 63.8978	9.9312 80.0868	11.0791 90.7996	11.6792 107.3338	
5.56	21.4251 107.2997	21.5344 129.6121	20.4796 152.3673	17.7526 177.4992	[illegible]33 [illegible]808	11.3704 243.5503	9.3368 297.5326	12.0194 344.6447	15.7649 12.5537	18.0165 38.4422	20.6006 61.0490	21.8769 83.1929	
7.41	37.0083 94.1295	36.5428 119.7803	34.7949 144.8886	31.2838 171.5076	27.2736 201.7129	23.2968 237.5880	21.6502 280.1376	24.8475 320.3754	30.0264 350.1210	33.6770 16.6411	36.0251 43.2559	37.1812 66.5401	
9.26	49.8882 85.4305	48.9045 112.4553	45.8225 139.3662	41.2348 168.6372	37.2607 200.7397	33.5871 237.5217	33.8360 277.9771	39.8780 313.0219	45.8625 339.8209	49.5049 4.7944	51.9093 31.2029	51.5830 57.8855	
11.11	57.1533 78.8963	54.7085 107.3778	51.0399 136.6837	46.5805 167.9607	42.6371 202.1633	40.7562 240.0588	43.7297 277.5193	51.2851 307.9843	56.8411 332.0783	59.9010 356.0145	60.6407 21.1701	59.5602 49.2185	
12.96	59.8893 73.7625	56.8577 103.9443	52.9880 135.1777	48.9620 158.4667	45.8379 204.2181	45.8806 241.7107	50.7363 276.0531	57.6558 302.7323	61.4242 325.8005	63.2624 349.5757	63.2745 14.2423	61.8345 42.5500	
14.82	59.9457 69.7357	57.0398 101.4500	53.2120 134.1294	49.7796 169.3303	47.7983 205.9241	49.2623 242.0810	54.7309 273.4392	59.9112 297.8355	62.2049 320.8549	63.5693 344.8245	63.5683 9.4733	61.9236 37.5079	
16.67	58.6341 66.6933	56.1579 99.6799	52.5230 133.3091	49.6143 159.9127	48.8896 206.8347	50.9828 241.3079	55.9351 270.2363	59.6030 293.9690	61.2977 317.2635	62.4120 341.6465	62.7176 6.4700	61.0987 34.1465	
18.52	56.7088 64.5433	54.5858 98.3872	51.1277 132.7553	48.6443 159.9112	49.1155 206.8164	51.1177 239.8744	54.8304 267.4534	57.9288 291.3265	59.5662 315.0690	60.7103 339.6360	61.3462 4.5470	59.7725 32.1373	
27.78	49.1065 61.0421	45.1662 97.0784	43.1945 134.1076	42.5715 171.0880	43.0159 205.0800	44.4961 236.2776	46.3510 263.6291	47.8436 288.7675	49.5866 313.3015	51.3233 337.5374	52.4197 1.6978	52.2124 28.6262	
37.04	45.2728 56.7323	39.7696 97.5055	36.9528 134.4318	36.5312 173.6887	37.3044 207.5973	38.4476 237.7296	39.8195 264.8620	41.3320 290.2116	42.8909 314.0582	44.5716 337.6588	45.9832 1.4205	46.6385 26.7547	
46.30	42.8763 52.9762	38.6754 90.4712	33.3399 136.6013	32.5023 175.7740	33.0528 209.7022	34.3592 238.8315	35.7942 265.1599	36.9910 289.9305	38.5378 313.7713	40.3178 337.4708	41.6510 0.5126	42.5946 25.0039	
55.56	40.7133 49.7864	39.0665 83.0596	32.9935 130.0420	30.6489 174.7542	30.8343 208.5712	32.0090 237.4987	33.2337 263.4524	34.3768 287.7866	35.7393 312.2285	37.3275 336.3530	38.8552 359.3153	39.7859 23.5156	
74.08	37.5183 44.9824	37.7037 73.9771	35.5396 109.4687	31.8107 153.2487	30.8217 190.6911	30.2106 223.0153	30.4323 252.7389	31.6155 279.3599	32.3880 305.7183	33.7019 331.5443	35.4440 355.8031	36.4279 19.9107	
92.60	35.0685 42.5418	35.3101 70.1158	34.6424 100.9789	32.4351 139.0673	30.6475 175.5715	29.1260 210.2039	28.6285 243.4364	29.0999 272.5863	29.7654 300.9460	31.1144 328.1399	32.5657 353.5531	33.8197 17.7304	
111.12	32.4035 41.8554	32.7519 68.5629	32.4719 97.8743	31.0776 132.5563	28.9388 169.2319	27.2036 204.3569	26.4352 238.4596	26.4748 269.8751	27.0522 299.5546	28.3805 327.1541	29.7633 353.3447	31.0907 17.7525	
138.90	28.2815 43.2272	28.7473 68.9896	28.6733 96.2629	27.4840 128.7042	25.3388 165.6596	23.4652 200.8346	22.4489 236.6335	22.3391 270.7484	22.8679 301.2101	24.1456 329.4261	25.6651 356.1083	27.0026 19.8623	
166.68	24.7912 45.7233	25.1641 70.2267	25.1344 96.4324	24.0163 127.2158	21.8495 163.4677	19.8143 200.1331	18.7196 237.6300	18.5394 273.7881	19.1710 305.7702	20.5720 333.9396	22.0708 8.2098	23.4578 23.5555	

Figure C4. Wind speed and direction fields, Snapshot 3, Hurricane Gilbert (Continued)

Azimuth (deg)

Radius from Eye (km)

222.24	19.4263 52.5043	19.8213 74.2517	19.7298 98.0311	18.6517 126.2601	16.4411 160.9138	14.2169 201.8043	12.9734 244.6368	12.8710 285.1865	13.9272 319.9934	15.4586 347.6928	16.9308 11.2714	18.3479 32.6243	Speed Direction
333.36	13.9063 64.9363	14.1066 82.2606	13.8576 100.7419	12.9278 123.0222	10.7125 152.6733	7.5966 192.3785	4.9740 256.6308	6.3039 325.4576	8.0198 357.1131	10.6869 17.2950	12.0612 35.5267	13.1697 50.5516	
444.48	11.2427 75.1767	11.4334 87.2204	11.1020 100.7976	10.0976 116.8226	8.2240 136.3901	4.7069 156.6264	0.6328 123.1347	4.0783 27.7766	6.9944 35.5119	8.9169 45.3005	10.0043 54.7053	10.7562 64.6989	
666.72	9.1315 85.0483	9.1445 91.8478	8.8858 98.1386	8.1880 104.9554	7.1286 109.5968	5.9349 109.3722	5.2327 98.4581	5.8709 84.3416	6.8978 76.6166	7.7410 75.1323	8.3600 77.5533	8.0415 81.2944	
888.96	8.2405 90.3331	8.2805 93.0460	8.1111 96.1245	7.7526 98.7809	7.2063 100.3613	6.8039 99.6455	6.5540 96.2318	6.7605 91.1883	7.1626 87.3125	7.5352 86.0833	7.8591 86.3592	8.1051 87.9600	
1111.20	7.7573 93.2421	7.8781 93.7816	7.8150 95.1536	7.5194 97.2275	7.3797 97.2090	7.1719 96.6678	7.0575 95.1169	7.1347 92.6936	7.3113 90.7668	7.4859 90.0865	7.6981 89.8485	7.7778 91.0940	
1333.44	0.0003 0.0003	7.5214 95.2758	7.5573 95.5072	0.0000 0.0000	7.2617 96.9223	7.3307 95.4119	0.0000 0.0000	7.3054 93.2323	7.2957 92.8484	0.0000 0.0000	7.6033 91.6804	7.4797 93.7834	

Figure C4. (Concluded)

Radius from Eye (km)

HOUR 6	0.	30.	60.	90.	120.	150.	180.	210.	240.	270.	300.	330.	
	Azimuth (deg)												
1.85	8.7587 130.1325	8.8609 144.1176	7.3751 153.1153	4.2912 155.2415	2.5068 156.7912	2.0796 108.7453	4.5386 82.6150	6.2876 75.2947	7.6405 81.8592	8.6340 95.7165	9.9054 103.4595	9.8593 114.1886	**Speed** **Direction**
3.70	10.8375 116.3443	19.1030 134.2980	10.1750 158.3503	14.5375 194.0287	12.0362 208.0766	8.9116 255.8552	6.5546 321.2597	9.5600 359.1774	13.7829 26.7049	15.3382 52.7187	17.4959 70.0827	19.7043 92.7629	
5.56	37.5673 95.1091	36.8985 119.9445	35.0398 144.4408	31.5218 171.5301	26.9624 202.3993	25.0200 238.3906	21.5355 280.2272	24.4005 321.0860	28.9509 351.1961	32.3592 18.9060	35.3477 44.8649	37.1843 69.2282	
7.41	52.9128 83.7693	51.7840 110.5392	48.8760 137.4012	43.8276 166.9833	39.4687 199.6220	35.9573 236.5251	36.1342 276.5432	41.3744 311.6202	46.8573 339.1888	50.9019 5.1511	53.5607 31.0470	54.2745 56.8400	
9.26	60.2722 76.9302	58.3198 104.9284	54.4180 134.3890	49.4879 166.1550	45.6554 200.7426	43.7012 239.1826	46.7360 276.5372	54.1535 307.2585	59.6512 332.3792	61.8504 356.6454	63.1055 21.5529	62.2520 48.5925	
11.11	61.7753 72.6413	59.2660 102.2596	55.3874 133.6112	51.2279 167.2547	48.1942 203.7365	48.5938 241.7413	53.6904 276.0303	60.4581 303.1634	63.7414 326.7779	65.3473 350.5936	65.2947 15.0675	63.7361 42.6865	
12.96	61.2395 69.6785	58.3882 100.8050	54.6777 133.7934	51.2651 169.1674	49.5085 206.5296	51.5784 243.0842	57.3364 274.3547	61.9926 299.2185	64.4038 322.2219	65.6817 346.0483	65.3203 10.7120	63.4411 38.5609	
14.82	59.8245 67.5272	56.6520 99.9906	53.1556 134.2455	50.5646 171.1573	50.0520 208.6410	53.0123 243.2906	58.3369 271.9716	61.5660 295.6800	63.3714 318.7164	64.5352 342.8263	64.3750 7.7321	62.3526 35.6283	
16.67	57.6073 66.0825	54.6111 99.6381	51.3413 134.6933	49.4066 172.7232	50.0538 209.8975	53.1536 242.6401	57.4593 269.5732	60.2171 293.0047	61.6626 316.2450	62.7707 340.5653	63.0473 5.6452	61.1262 33.5158	
18.52	55.4695 64.9577	52.3678 99.5450	49.2613 135.2441	47.8018 173.6429	49.4475 210.2933	52.1987 241.6570	55.4311 267.6989	58.0281 291.2797	59.6404 314.7228	60.8260 338.9867	61.5085 3.9918	59.7965 31.9720	
27.78	50.1195 60.0535	43.6728 100.9003	41.1260 140.0168	41.2747 177.4193	42.7040 210.2038	44.6806 239.2319	46.5540 264.8191	47.9773 288.8106	49.6243 312.7312	51.3458 336.5960	52.6041 0.2626	52.9814 26.8418	
37.04	47.4352 52.1713	42.8484 93.2250	37.3719 140.2711	36.9134 178.6740	38.1672 210.9635	39.5486 237.8774	40.8154 262.9508	42.1068 287.4088	43.4624 311.8902	45.0299 335.0175	46.5261 358.7277	47.4065 23.5724	
46.30	44.6671 47.7362	43.0607 81.1588	37.9987 126.2534	35.4313 170.9221	35.5423 204.7558	36.4978 232.3740	37.4746 258.3769	38.3551 283.3055	39.5725 307.9628	41.1783 332.8188	42.5740 356.6253	43.6238 20.9968	
55.56	42.3251 44.5523	42.1377 74.7401	39.3022 113.0455	36.2074 157.2174	35.1539 192.7052	34.9848 223.4742	35.4557 251.9711	36.1846 278.0828	37.0296 304.2329	38.4968 329.9261	40.0062 354.4014	41.0682 18.8977	
74.08	38.4857 41.6474	39.0401 68.9723	38.2846 100.5228	36.3313 137.9882	34.8051 174.4284	33.0439 207.9971	32.3817 240.3938	32.9078 269.6181	33.2506 298.0038	34.4868 325.1486	36.0990 351.1395	37.3015 15.0877	
92.60	34.7073 40.6172	35.1943 67.4680	35.0407 96.5829	33.5377 131.6945	31.5331 167.4435	29.8140 201.7901	28.9698 235.8551	28.8042 266.6570	29.2671 296.4031	30.5728 324.5994	31.9501 351.1093	33.3674 15.7644	
111.12	30.9171 41.7627	31.4111 67.7507	31.3769 95.8992	30.1923 128.7989	28.0657 164.8235	26.2388 199.9140	25.2340 234.7326	24.9818 267.2635	25.4027 298.1273	26.6939 326.5109	28.0788 353.2555	29.5367 17.8723	
130.90	26.0183 44.9943	26.5379 69.9380	26.5597 96.0423	25.4220 127.0765	23.2675 163.7434	21.2980 199.2784	20.1232 236.1404	19.8343 271.8036	20.3927 303.2742	21.7892 332.0342	23.2620 358.8414	24.6844 22.2574	
166.68	22.3613 48.7092	22.7341 72.2471	22.7297 97.1235	21.7449 126.3747	19.4088 [illegible]	17.2560 200.0002	16.0768 239.1773	15.8073 277.9383	16.5483 310.9147	18.0589 339.0564	19.5601 5.1367	21.0074 27.6600	

Figure C5. Wind speed and direction fields, Snapshot 4, Hurricane Gilbert (Continued)

Radius from Eye (km)	Azimuth (deg)												
222.24	17.2247	17.6536	17.5174	16.4740	14.2267	11.7834	10.3609	10.4290	11.0034	13.4415	14.8759	16.2609	Speed
	57.3792	77.4231	99.4562	125.0515	159.5671	201.2067	249.8243	295.1810	330.8544	357.6495	19.4685	39.0515	Direction
333.36	12.5875	12.7505	12.4597	11.5546	9.4265	5.6681	2.2301	4.9374	7.7820	9.6954	11.0085	11.9226	
	70.8165	85.9578	101.8971	121.2253	146.4231	180.7132	261.4461	353.5182	16.3208	31.5602	46.1408	58.5154	
444.48	10.4183	10.5605	10.2281	9.3480	7.6181	4.8645	2.6578	4.6404	6.9516	8.4713	9.3869	10.0899	
	80.4844	90.3027	101.2231	113.6680	127.5735	135.8766	101.3300	55.5247	52.6874	58.0583	64.4418	72.0876	
666.72	8.7868	8.7969	8.5321	7.9987	7.2481	6.4323	5.9430	6.3725	7.0713	7.6877	8.1610	8.9233	
	89.2693	93.7684	98.3721	133.1315	105.9531	105.3618	98.8360	89.6426	83.5594	81.7757	83.1927	85.8526	
888.96	8.0996	8.1212	7.9856	7.7204	7.3885	7.0508	6.6372	7.0898	7.2963	7.5711	7.8153	8.0008	
	92.5533	94.5714	96.7962	98.6809	99.7154	99.1711	96.8599	93.4547	90.6046	89.5574	89.6578	90.7763	
1111.20	7.6842	7.8127	7.7697	7.5105	7.4448	7.3042	7.2160	7.2743	7.4108	7.5394	7.7054	7.7495	
	94.6995	95.0867	96.0967	97.6676	97.5864	97.1599	96.0514	94.3445	92.9100	92.3456	92.1451	93.0694	
1333.44	0.0000	7.4844	7.5363	0.0000	7.2920	7.4118	0.0000	7.3940	7.3656	0.0000	7.6297	7.4519	
	0.0000	96.2097	96.4078	0.0000	97.4912	96.2850	0.0000	94.6869	94.3605	0.0000	93.4625	95.8748	

Figure C5. (Concluded)

Azimuth (deg)

Radius from Eye (km) HOUR 8	0.	30.	60.	90.	120.	150.	180.	210.	240.	270.	300.	330.	
1.85	9.6751	10.2850	8.9701	5.0424	3.2845	0.8951	3.6303	5.7292	7.2887	8.8195	10.3624	10.5073	Speed
	131.4745	145.4287	156.9169	172.0941	193.3322	154.8410	67.7335	61.6868	73.5712	92.5335	100.5165	112.8158	Direction
3.70	22.1154	22.7124	21.9172	18.5023	15.4906	12.6597	10.3164	11.1921	14.4920	16.1192	18.7350	21.8567	
	109.9075	128.9179	153.2021	178.0285	203.3124	244.9841	291.1562	334.8825	12.5355	41.1665	63.6837	87.3422	
5.56	40.1334	39.9098	37.9009	34.4004	29.6840	25.5187	23.7446	24.9115	28.1012	31.6102	35.5339	38.3884	
	92.3423	116.0332	140.1048	157.1422	197.5324	232.5270	272.5745	313.3778	347.0220	16.9131	43.8711	67.8416	
7.41	52.3583	51.6783	48.7181	43.5401	38.7187	34.6514	33.8177	37.2201	41.8973	46.4364	50.2437	52.1404	
	82.7491	107.6458	133.5187	152.6378	194.9618	231.9661	272.7785	309.9891	340.8087	8.4163	33.8683	58.0636	
9.26	57.4635	55.8262	52.0313	46.7359	41.8824	38.8237	40.5396	46.5423	52.5419	56.6999	58.8566	58.7275	
	77.0044	102.4278	130.4785	161.4817	195.8730	235.8373	276.2597	310.3051	337.8590	2.2698	26.4653	51.4714	
11.11	58.4125	55.7518	51.8363	46.9532	42.4548	41.3062	45.6567	53.2949	59.1010	61.8473	62.0448	60.5073	
	73.6843	100.3186	129.5666	152.3754	199.3918	240.6132	279.3333	309.6859	333.3705	356.4786	20.5449	46.7478	
12.96	57.7041	54.4603	50.5099	45.9986	42.4690	43.4062	49.7304	57.4779	61.6746	63.6587	63.3929	61.0737	
	71.8665	99.6831	129.9590	164.5091	203.5671	244.9716	280.7195	306.9131	328.5965	351.0187	15.2445	42.7951	
14.82	56.6703	52.6970	48.7169	44.6986	42.4143	45.3132	52.6519	59.2950	62.1835	63.7755	63.7622	61.3841	
	70.4987	99.9625	131.1084	157.2946	207.8051	248.1551	280.2346	302.9649	323.8678	346.1907	10.5203	38.8536	
16.67	55.9263	50.9480	46.9299	43.3869	42.5826	46.9449	54.1366	59.3921	61.5424	62.8809	63.4332	61.5361	
	68.7115	100.8564	132.7207	170.2668	211.6031	249.7689	278.0131	298.8218	319.6397	342.2645	6.4784	34.9733	
18.52	55.7145	49.3525	45.2176	42.1794	42.8823	48.0471	54.2336	58.3783	60.2713	61.5158	62.5274	61.2415	
	66.0263	101.9839	134.7840	173.0711	214.5717	249.8736	274.8112	295.0137	316.2557	339.2260	3.1047	31.3807	
27.78	56.3915	50.0561	43.0713	41.8983	44.6678	47.7939	50.1354	51.4039	52.7310	54.3364	55.7974	56.4496	
	50.9549	93.5489	140.5219	180.3135	212.5276	237.7064	260.2533	282.9339	306.7090	331.0107	354.6830	20.6344	
37.04	52.7183	52.1626	47.6326	44.7637	45.5878	45.6691	46.1380	47.2151	47.8018	49.1724	50.7911	51.7145	
	42.9993	76.4174	119.6424	152.3575	193.8726	221.9692	249.0466	274.2194	299.8688	325.4520	350.3728	15.6125	
46.30	49.4945	49.4471	47.8230	45.4751	44.7144	43.6323	43.3631	43.7702	44.2846	45.7043	46.9640	48.2408	
	39.2413	69.7949	105.5398	145.5435	178.7207	299.9461	240.3633	267.5006	294.6684	321.3986	347.3514	12.4789	
55.56	46.2685	46.5732	45.7621	44.3816	42.7059	41.2463	40.7339	40.6701	41.0167	42.3565	43.5703	44.9282	
	37.3013	66.5894	99.7081	136.7935	171.3428	203.5123	234.6566	263.6939	291.9500	319.1009	345.8168	11.2623	
74.08	39.5081	40.0985	39.8577	38.4805	36.8042	35.0998	34.2324	33.9715	34.2099	35.3791	36.7413	38.1708	
	37.3604	65.2433	95.7058	130.4793	166.0707	198.8785	231.0133	262.2479	291.5577	319.3531	346.7242	12.0480	
92.60	33.7762	34.2900	34.2436	33.0132	30.9387	29.2265	28.3528	27.7856	28.1982	29.5159	30.8170	32.3096	
	39.5585	66.2406	94.9796	128.9923	164.2848	198.2890	232.0567	263.9776	294.3946	322.9063	349.9463	14.8319	
111.12	29.0925	29.6314	29.6101	28.4479	26.3126	24.4781	23.4583	22.9706	23.4993	24.7850	26.2034	27.7856	
	42.4703	68.0642	95.8500	128.4033	164.1621	199.4439	234.5357	267.6903	299.1831	327.8202	354.4448	18.9214	
130.90	24.1865	24.6175	24.5826	23.4337	21.1983	19.1848	18.0353	17.7646	18.4161	19.7943	21.3652	22.7997	
	46.8933	71.3079	96.8819	127.6676	164.5188	200.6886	238.5296	275.0992	307.0056	335.7682	1.9959	24.8899	
166.68	20.7313	21.0832	21.0026	20.0055	17.5596	19.3519	14.2382	14.0643	14.9368	16.5062	18.0036	19.4459	
	51.0565	73.9968	98.2159	127.0672	163.4597	202.0984	242.9711	283.3518	316.4691	344.0491	9.3061	30.8865	

Figure C6. Wind speed and direction fields, Snapshot 5, Hurricane Gilbert (Continued)

Azimuth (deg)

Radius from Eye (km)													
222.24	16.2366 59.8413	16.6459 79.1087	16.4392 100.3974	15.3768 126.2712	13.1025 159.5487	10.4623 202.5034	8.9548 254.9291	9.3177 302.8154	10.9143 337.9561	12.6443 3.3012	14.0424 24.0113	15.3706 42.3546	Speed Direction
333.36	12.3012 72.0442	12.4639 86.6573	12.1373 102.1036	11.2045 120.8771	9.1403 144.8609	5.3362 175.7883	1.4354 261.1511	4.7068 2.2034	7.5888 21.3593	9.5158 35.0852	10.8113 48.3594	11.6709 60.1233	
444.48	10.4068 80.4962	10.5438 90.3538	10.1955 101.2533	9.3108 113.6536	7.5925 127.3365	4.9766 135.4106	2.8550 105.5514	4.5665 58.9183	6.8749 54.0608	8.4160 58.5198	9.3632 64.5604	9.9960 72.0837	
666.72	8.9076 88.4529	8.9256 93.4644	8.6443 98.6051	8.0536 103.9265	7.2200 107.3191	6.3117 106.9290	5.7509 99.9562	6.1776 89.5139	6.9492 82.4030	7.6584 80.2801	8.2133 81.6490	8.6281 84.5907	
888.96	8.2143 91.7631	8.2438 94.2089	8.0752 97.0343	7.7502 99.4183	7.3391 100.7916	6.9206 100.2156	6.7107 97.4378	6.8465 93.1732	7.1903 89.5305	7.5405 88.1052	7.8514 88.1994	8.0865 89.5728	
1111.20	7.7753 94.1829	7.9021 94.8481	7.8292 96.2721	7.5234 98.2272	7.3981 98.3170	7.1983 97.8259	7.0787 96.3525	7.1490 94.0699	7.3257 92.0809	7.5069 91.2263	7.7262 90.9856	7.8094 92.1210	
1333.44	0.0003 0.0003	7.5508 96.0205	7.5720 96.5524	0.0000 0.0000	7.2542 98.0108	7.3270 96.7118	0.0000 0.0000	7.2973 94.4424	7.2964 93.7458	0.0000 0.0000	7.6429 92.5505	7.5029 94.3668	

Figure C6. (Concluded)

Radius from Eye (km)	Azimuth (deg)												
HOUR 10	0.	30.	60.	90.	120.	150.	180.	210.	240.	270.	300.	330.	
1.85	9.5756	10.1489	8.8140	4.8803	3.2036	0.7628	3.5340	5.7002	7.2473	8.7838	10.3057	10.4284	Speed
	131.3066	145.5391	157.1742	172.3176	195.9045	173.6769	65.1313	60.1013	72.6960	92.2133	100.2788	112.6051	Direction
3.70	21.8363	22.5112	21.8087	18.4959	15.6772	12.9956	10.6750	11.3403	14.4418	16.0212	18.5949	21.6802	
	110.0727	129.3418	153.8130	178.8702	204.2604	245.2943	290.2307	333.2014	11.7009	40.7630	63.4798	87.3928	
5.56	39.9683	39.8819	38.0393	34.7197	30.2136	26.1395	24.1395	24.9039	27.7189	31.2022	35.2078	38.1353	
	92.8095	116.5906	140.6766	157.7189	197.8380	232.1158	271.3482	311.9154	346.3321	16.8020	44.1054	68.1871	
7.41	52.4135	51.9334	49.1763	44.1494	39.4865	35.3483	33.9757	36.6696	40.9140	45.5616	49.7462	51.9256	
	83.3271	108.1837	133.9338	162.8399	194.7056	230.8546	271.0784	308.6703	340.6495	9.0339	34.6334	58.6751	
9.26	57.6395	56.2852	52.6725	47.4795	42.6542	39.2353	40.1104	45.2065	50.9773	55.5250	58.2599	58.6482	
	77.5739	102.7956	130.6036	151.2547	194.9869	234.1264	274.5155	309.6470	338.6639	3.8183	27.8842	52.3983	
11.11	58.7303	56.2693	52.5187	47.6951	43.0319	41.2267	44.5365	51.5284	57.5391	61.0180	61.5788	60.4665	
	74.2327	100.5106	129.3953	151.7234	197.9701	238.6584	278.1257	310.1827	335.2515	358.7165	22.5929	47.9914	
12.96	58.0383	54.9767	51.1652	46.6519	42.7534	42.8059	48.2579	55.9123	60.8256	63.1204	63.0071	61.0043	
	72.4717	99.7595	129.5476	163.4785	201.7781	243.2130	280.4522	308.5649	331.0397	353.6751	17.7420	44.4688	
14.82	56.9963	53.1903	49.3068	45.2064	42.3613	44.2989	51.1619	58.3005	61.7839	63.5989	63.5568	61.3137	
	71.2343	99.9851	130.5242	165.9660	205.8608	246.9568	281.0129	305.3955	326.5873	348.8626	13.1631	40.9376	
16.67	56.2454	51.4185	47.4392	43.7170	42.2027	45.7262	53.0354	59.0150	61.5397	63.0095	63.4761	61.5397	
	69.7832	100.8813	132.0443	168.7637	209.7567	249.3455	279.8398	301.5139	322.2606	344.6946	8.9953	37.2638	
18.52	56.0443	49.8188	45.6521	42.3345	42.2330	46.8669	53.5306	58.4784	60.5426	61.8415	62.8233	61.4017	
	67.4005	102.0571	134.0959	171.5683	213.0774	250.3013	277.1290	297.5455	318.5396	341.3363	5.3063	33.6166	
27.78	57.1843	51.0161	43.6755	41.8925	44.5440	48.1017	50.8526	52.2907	53.6941	55.3218	56.8046	57.3805	
	52.3207	93.9816	140.0392	180.1006	213.5217	239.1872	261.4302	283.8847	307.5496	331.8659	355.5528	21.7381	
37.04	53.9147	53.4386	49.0093	45.8119	46.7055	46.8030	47.2721	48.4672	49.0258	50.3930	52.0557	52.9292	
	43.6042	76.7432	118.9008	161.5761	193.3779	221.6850	248.9171	274.0432	299.8261	325.5730	350.5764	16.8257	
46.30	50.8063	50.7789	49.2526	46.9166	46.1723	45.0147	44.7327	45.1290	45.6161	47.0309	48.2946	49.5576	
	39.5247	70.0083	105.1282	144.5289	177.4712	209.0611	239.6466	266.9175	294.2257	321.1307	347.2445	12.5691	
55.56	47.5335	47.8519	47.1005	45.7905	44.0913	42.6074	42.1137	41.9868	42.3103	43.6506	44.8514	46.2041	
	37.4645	66.7894	99.5110	135.9901	170.4592	202.6401	233.8541	263.0301	291.4028	318.6991	345.6003	11.2397	
74.08	40.5411	41.1248	40.9084	39.5807	37.9022	36.1926	35.3174	35.0257	35.2475	36.4124	37.7678	39.1964	
	37.5313	65.5270	95.7975	130.1001	165.4775	198.2427	230.3507	261.6772	291.0672	318.9815	346.5262	12.0373	
92.60	34.5822	35.0865	35.0508	33.8660	31.7985	30.0720	29.1336	28.5955	28.9941	30.3147	31.6080	33.1035	
	39.8003	66.6141	95.2519	128.8554	163.8989	197.8069	231.5259	263.4983	293.9749	322.6035	349.8277	14.8860	
111.12	29.7222	30.2573	30.2373	29.1093	26.9763	25.1259	24.1345	23.5935	24.1120	25.3994	26.0183	28.3268	
	42.7934	68.5360	96.2709	128.4688	163.9217	199.0788	234.1369	267.2756	298.8248	327.5867	354.3762	19.0502	
138.90	24.5593	25.0718	25.0241	23.9061	21.6714	19.6445	18.4508	18.1941	18.8394	20.2230	21.8041	23.2465	
	47.3193	71.9082	97.4697	127.9666	164.4535	200.4520	238.1339	274.7439	306.7056	335.6149	2.0347	25.0401	
166.67	21.0675	21.4215	21.3219	20.3567	17.9032	15.6757	14.5171	14.3544	15.2304	16.8151	18.3237	19.7782	
	51.5822	74.7010	98.9339	127.5326	163.5388	201.9574	242.6123	283.0029	316.2121	343.9663	9.4450	31.2207	

Figure C7. Wind speed and direction fields, Snapshot 6, Hurricane Gilbert (Continued)

Azimuth (deg)

Radius from Eye (km)													
222.24	16.4351 60.5353	16.8498 79.9834	16.6179 101.2857	15.5711 127.0105	13.2937 159.8906	10.6382 202.5562	9.1123 254.8345	9.4671 302.6729	11.0719 337.9539	12.8149 3.4953	14.2247 24.3332	15.5699 42.8843	Speed Direction
333.36	12.3933 73.0761	12.5517 87.7937	12.2023 103.1885	11.2806 121.8343	9.2285 145.4821	5.4461 175.9317	1.4396 259.7232	4.7539 3.0542	7.6746 22.0272	9.6007 35.8081	10.9031 49.1652	11.7589 61.0295	
444.48	10.4616 81.6973	10.5918 91.5825	10.2240 102.3836	9.3475 114.6559	7.6592 128.1180	5.0810 136.1546	2.9607 107.9575	4.5965 60.5688	6.9331 55.2227	8.4802 59.5774	9.4155 65.6380	10.0486 73.2025	
666.72	8.9342 89.7336	8.9407 94.7250	8.6551 99.7505	8.0737 104.9848	7.2574 108.3151	6.3673 107.9895	5.8335 101.3385	6.2065 91.1226	6.9752 83.8425	7.6908 81.5827	8.2476 82.9376	8.6609 85.8631	
888.96	8.2403 93.0151	8.2522 95.5210	8.0821 98.1807	7.7626 100.5187	7.3619 101.8678	6.9518 101.3242	6.7379 98.6126	6.8665 94.5295	7.2164 90.8974	7.5664 89.4371	7.8772 89.5126	8.1125 90.8602	
1111.20	7.7809 95.0633	7.9091 95.9823	7.8331 97.4070	7.5249 99.2048	7.4116 99.4150	7.2193 98.9630	7.0974 97.5309	7.1651 95.3587	7.3488 93.4042	7.5347 92.4910	7.7513 92.2960	7.8297 93.3073	
1333.44	0.0003 0.0003	7.5538 96.8489	7.5697 97.5185	0.0000 0.0000	7.2373 98.8891	7.3415 97.8577	0.0000 0.0000	7.3109 95.6954	7.3146 94.8563	0.0000 0.0000	7.6652 93.7957	7.5051 95.2227	

Figure C7. (Concluded)

HOUR 12	0.	30.	60.	90.	120.	150.	180.	210.	240.	270.	300.	330.	
1.85	16.3507 89.0783	15.5492 109.9267	14.7316 133.8400	14.1334 157.4741	11.8043 182.6445	9.6663 217.8008	8.8377 259.2302	7.6613 305.1008	9.3323 351.2107	12.1211 19.4790	13.1807 45.4047	14.7227 69.5132	**Speed** **Direction**
3.70	21.1541 87.0193	21.0080 111.0501	20.1167 133.8895	18.6866 151.1057	16.5956 190.6693	14.7980 221.6384	13.6513 260.5367	13.3480 301.2857	14.2768 336.8775	16.4207 10.3235	18.4283 39.0295	19.9848 62.6439	
5.56	23.6835 88.0137	23.5946 111.9452	22.6916 136.7157	21.2237 153.5315	19.1422 192.3614	17.2592 224.7860	16.1425 261.0360	15.7209 298.7363	16.6401 335.5961	18.6777 8.6204	20.6577 37.5690	22.4651 63.5799	
7.41	25.2937 89.2573	25.3959 113.3252	24.4926 137.8749	22.8102 154.6263	20.7299 193.6826	18.7836 225.7666	17.4735 261.6153	17.1555 298.9221	18.0420 335.2518	19.9639 8.8027	22.1604 38.1935	24.0734 64.4630	
9.26	26.4703 90.1273	26.6732 113.8179	25.7461 138.4842	23.9256 154.6467	21.6698 193.5282	19.5501 226.3671	18.1582 262.0797	17.8697 299.2006	18.8344 336.1495	20.7806 9.4293	23.0651 38.8563	25.1629 65.6881	
11.11	27.3912 90.3942	27.6545 113.8165	26.7276 137.7407	24.7707 153.8200	22.2290 192.8550	19.9230 225.8495	18.4369 262.4388	18.2280 300.2133	19.2976 336.7144	21.3558 10.0514	23.7542 39.6523	25.9406 66.0507	
12.96	28.0793 90.0713	28.3793 112.9781	27.4410 136.4615	25.3956 162.3443	22.6006 191.3785	20.0496 225.0270	18.5568 262.6160	18.3867 301.0903	19.6245 337.5178	21.8171 10.5188	24.2756 39.8327	26.5268 65.9698	
14.82	28.4976 89.2517	28.8117 111.7167	27.8449 134.8552	25.7704 160.5361	22.8019 189.4996	19.9705 223.8541	18.4324 262.8109	18.3916 302.0388	19.8217 338.4953	22.1659 10.8613	24.6413 39.5920	26.8754 65.4556	
16.67	28.5963 88.2287	28.9769 110.4239	27.9598 133.2625	25.8431 158.6981	22.8641 187.6121	19.7458 222.4896	18.1156 262.9525	18.3106 303.1747	19.9421 339.6518	22.4137 11.2531	24.8926 39.1221	27.0094 64.6557	
18.52	28.3763 87.2983	28.8763 109.3154	27.7638 132.0436	25.6165 157.1613	22.7516 185.8946	19.3575 221.2597	17.6332 263.2337	18.1333 304.5507	19.9968 341.2560	22.5799 11.9560	25.0168 38.6357	26.9386 63.9194	
27.78	27.5243 87.5406	27.2295 110.0839	26.1451 132.7934	23.8829 157.0876	20.6571 185.6173	17.2621 223.3199	15.8151 271.3176	17.7982 316.9973	21.9103 351.2734	25.5891 17.0865	27.4991 40.1838	27.8356 63.5865	
37.04	31.2762 82.9185	27.9659 114.0202	26.1313 138.1578	23.2087 153.5896	19.4146 194.3630	16.8069 235.4245	16.9352 284.0775	21.3056 326.1669	27.8439 349.6353	32.5133 8.8418	35.4657 29.3420	34.7732 53.2386	
46.30	37.7603 66.7695	33.9877 102.8611	30.1342 136.4655	26.0590 156.9946	21.9835 201.8652	20.7687 242.0467	22.8364 281.6146	28.7706 311.7523	33.9363 329.5922	36.8290 350.4365	39.4773 11.4625	39.9090 36.2228	
55.56	41.0651 54.9455	39.6166 87.9684	35.2725 125.2973	31.0728 152.0964	28.0371 197.8336	27.2107 233.8171	29.7501 266.9597	33.5735 291.5663	36.3337 314.0026	38.1652 338.2691	40.0415 1.2881	40.8103 26.6225	
74.00	39.5231 46.0911	39.7257 75.7024	37.9999 108.9256	35.4729 145.6304	34.3411 180.5994	32.8975 213.7917	32.6347 245.9422	33.8150 274.2275	34.5005 301.9324	35.7351 328.9923	37.5626 354.2159	38.5469 19.6270	
92.60	36.0367 44.9325	36.1649 73.1756	35.2514 104.0901	33.5062 139.1711	31.8309 173.2745	30.2987 207.3613	29.7382 241.3360	30.0229 271.0671	30.7258 300.3315	32.0837 328.2963	33.5911 353.9312	34.8308 19.0611	
111.12	32.5401 45.7519	32.7556 73.1789	32.0507 103.0804	30.6643 136.6625	28.6943 171.1954	27.0738 206.1395	26.4187 240.4534	26.4412 272.0221	27.2036 302.1886	28.5653 330.1808	30.0238 355.9885	31.3351 20.8932	
138.90	28.2075 48.2681	28.5583 74.8537	27.9393 102.9048	26.5857 135.1480	24.5283 170.8138	22.7337 206.0461	21.8960 242.1395	22.0497 276.2384	22.8525 306.5859	24.2383 334.7673	25.8227 0.6820	27.1164 24.3947	
166.68	25.0965 50.9229	25.3670 76.3824	24.7697 103.5784	23.5271 134.5078	21.2642 170.2056	19.2766 206.8717	18.4352 244.6567	18.6395 280.8321	19.5896 312.0575	21.1372 339.7440	22.6660 9.2076	24.0119 28.2087	

Azimuth (deg)

Radius from Eye (km)

Figure C8. Wind speed and direction fields, Snapshot 7, Hurricane Gilbert (Continued)

Radius from Eye (km)		Azimuth (deg)											
222.24	Speed	20.8111	21.1562	20.5631	19.3016	16.9316	14.7055	13.7515	14.0595	15.4084	17.1109	18.5938	20.0075
	Direction	56.5135	79.5689	104.8740	134.4426	168.6485	208.7104	251.7507	290.6839	323.5586	350.5375	13.8485	35.3829
333.36	Speed	16.5683	16.8229	16.1883	15.0640	12.7686	10.1152	8.3360	9.3517	11.2449	13.1382	14.6756	15.9211
	Direction	63.7667	84.[illegible]25	105.9528	131.8642	164.1942	204.0379	259.0377	311.2555	343.9753	7.6778	28.1276	45.8844
444.48	Speed	14.3125	14.5290	13.9106	12.7955	10.6628	7.5634	4.4322	5.9584	9.1516	11.1680	12.7089	13.7544
	Direction	69.7093	87.1939	106.3930	129.4631	156.7112	193.7780	258.7397	332.3108	2.9151	22.1557	38.5595	53.9381
666.72	Speed	12.0379	12.1576	11.5583	10.4951	8.6628	5.4686	1.7338	3.0931	6.7957	9.2559	10.7025	11.5151
	Direction	76.7527	90.8665	105.5704	123.0008	143.2619	164.4315	176.2188	32.3861	35.6422	43.9454	53.7976	64.6449
888.96	Speed	10.7475	10.8701	10.3390	9.3544	7.7021	5.3080	3.1535	3.5826	6.1556	8.2307	9.5811	10.3149
	Direction	81.8002	92.6319	104.3400	117.4387	131.1810	140.7968	127.6371	77.3321	59.1984	59.1180	64.0683	72.1120
1111.20	Speed	9.9243	10.0597	9.5647	8.5923	7.3180	5.5693	4.1778	4.5115	6.0912	7.7176	8.9865	9.5568
	Direction	85.9545	94.0334	103.4656	114.3397	122.5274	126.4194	114.9610	88.4732	72.1534	68.8356	71.2967	77.7603
1333.44	Speed	0.0003	9.4190	8.9686	0.0000	7.0382	5.7541	0.0360	5.1692	6.0791	0.0000	8.5450	9.0801
	Direction	0.0003	95.4576	103.4790	0.0000	117.4715	118.2853	0.0300	92.4314	79.4402	0.0000	76.5999	82.1642

Figure C8. (Concluded)

Radius from Eye (km)						Azimuth (deg)							
HOUR 14	0.	30.	60.	90.	120.	150.	180.	210.	240.	270.	300.	330.	
1.85	6.3147 113.4983	6.2123 117.9277	5.7882 118.9495	5.1433 115.4730	4.7471 113.6873	4.7461 107.9817	5.1945 101.1154	5.4502 96.6061	5.8912 97.0941	6.4116 101.4459	6.8043 103.3165	6.7546 107.4558	Speed Direction
3.70	9.3112 109.5661	9.0842 121.3492	8.2132 135.8164	6.4910 145.0103	4.7180 151.1653	2.4063 143.8505	2.1578 90.4703	3.6093 65.2639	5.8876 64.1783	7.4573 74.3638	8.6532 83.6806	9.4594 96.7260	
5.56	13.1143 101.9884	13.0417 121.2035	12.2754 140.1766	10.6279 150.5241	8.2434 185.4784	5.1929 219.9188	3.2335 285.0376	5.1488 349.4021	7.9992 19.9757	10.1942 42.8766	11.7575 63.3147	12.7349 82.7475	
7.41	16.8883 97.9113	17.0289 119.8363	16.2297 141.6720	14.5031 165.5396	12.2905 193.9507	10.0180 230.2839	8.8706 277.5774	9.8225 322.8787	11.5782 357.6623	13.3750 26.5580	15.0022 51.7343	16.1879 75.3055	
9.26	20.2743 96.4741	20.6665 119.6323	19.9056 142.4797	18.0561 157.1964	15.6928 196.3895	13.4850 231.8090	12.4596 273.3212	13.1633 313.5428	14.5065 348.1594	16.1560 18.8159	17.9045 46.3690	19.2206 72.1667	
11.11	23.1823 95.8632	23.7701 119.3792	23.0668 142.4355	21.1463 167.3588	18.5180 196.2962	16.0879 230.9066	14.9322 270.5374	15.4324 309.1006	16.6394 343.8620	18.3887 15.2845	20.1893 44.1615	21.8452 70.9994	
12.96	25.6683 95.1535	26.3959 118.3341	25.6746 141.2413	23.6869 166.2525	20.7533 194.8393	18.0016 229.2747	16.7268 268.4595	17.0047 306.9566	18.3025 342.0144	20.1465 13.6836	22.0899 43.0220	24.0113 70.1846	
14.82	27.6935 93.9036	28.4618 116.5405	27.6445 139.2284	25.5862 164.2686	22.4223 192.6340	19.2911 227.2160	17.8150 267.0525	18.0439 306.0743	19.4890 341.5164	21.5674 13.0753	23.6959 42.1994	25.7950 69.1750	
16.67	29.1255 92.1621	29.9088 114.3554	28.9356 136.8800	26.7639 161.9113	23.5632 190.2466	20.0442 225.0539	18.3433 266.0706	18.7069 306.0851	20.3842 341.9318	22.7366 13.0989	25.0475 41.4082	27.1694 67.8509	
18.52	29.8652 90.2423	30.7179 112.1667	29.5651 134.6950	27.2449 159.7209	24.1947 188.0476	20.3251 223.1442	18.3397 265.5989	19.0814 306.8276	21.0763 343.1575	23.7232 13.6250	26.1438 40.6421	28.1101 66.4047	
27.78	30.7133 87.0723	30.1161 109.7474	28.8644 132.7295	26.4438 157.6473	22.9905 186.7729	19.2543 224.6622	17.7383 273.0411	20.4126 318.7719	25.5789 352.2397	30.1293 16.9688	32.2792 39.3419	31.9115 62.5939	
37.04	35.9043 80.2313	30.4563 113.9165	28.3070 138.5709	25.1191 164.5568	21.2918 196.1048	18.8711 238.2922	19.7367 286.6393	25.7924 326.8619	33.8092 347.6337	39.1871 5.1335	42.2181 24.8516	41.1328 49.1850	
46.30	43.7292 63.5261	38.1410 102.3553	32.5712 139.5650	27.5068 171.5198	23.1957 208.1351	23.3939 248.3961	27.2599 284.5951	34.8386 310.8670	40.5233 326.7548	43.2903 347.1288	45.9631 7.8484	46.1238 32.9169	
55.56	47.7511 51.4451	45.8581 85.3982	39.9195 126.0048	34.2487 166.3225	30.9706 204.1390	31.6531 238.4617	35.8531 267.7523	40.2867 289.2571	43.0496 310.8600	44.7792 334.9314	46.7223 357.9631	47.1961 23.3347	
74.08	47.3631 41.0384	47.7271 70.8107	46.1813 104.1061	43.7267 141.5234	43.0469 176.0860	41.3600 209.0109	40.9791 240.5930	42.3924 267.7920	42.6332 295.4653	43.8149 322.5008	45.5705 348.3860	46.3935 14.1311	
92.60	44.3671 38.2863	44.6299 67.0357	44.1783 97.6673	42.7210 132.5309	41.1718 166.5017	39.6451 199.6509	38.9101 232.5516	39.0944 262.0262	39.4565 290.9577	40.7029 319.0395	41.9655 345.9387	43.1862 11.6524	
111.12	40.4933 38.0974	40.7662 64.2596	40.5500 94.0790	39.5421 129.1239	37.6938 163.5459	36.1250 196.9658	35.4345 229.9458	35.0934 261.0835	35.4555 290.8629	36.7140 319.0163	37.8652 346.4571	39.1700 12.3195	
138.90	34.7274 40.1923	35.1190 67.6828	34.9954 95.9495	33.9624 127.8322	32.1415 162.9781	30.4496 196.3827	29.5338 230.3771	29.2223 263.6073	29.5757 293.7062	30.7724 322.2280	32.1345 350.0675	33.4266 15.1750	
166.68	30.1803 43.0544	30.4352 69.5180	30.3078 97.0648	29.4031 127.8678	27.3718 162.8317	25.5357 197.5289	24.6243 232.4344	24.2397 267.1837	24.7240 298.4638	26.0802 326.8257	27.4266 354.3822	28.7774 19.1913	

Figure C9. Wind speed and direction fields, Snapshot 8, Hurricane Gilbert (Continued)

Radius from Eye (km)	Azimuth (deg)												
222.24	23.5575 49.9887	23.9216 74.0585	23.6923 99.7461	22.7057 129.2268	20.5727 163.1637	18.5328 200.5521	17.4319 239.7561	17.1813 276.7259	18.0937 310.2991	19.5530 339.0927	21.0256 4.4320	22.4507 27.8618	Speed Direction
333.36	16.9581 68.9523	17.2036 81.7746	16.7890 103.3250	15.8408 128.7525	13.5750 161.3663	11.1491 200.5323	9.5254 251.2571	9.9522 302.6403	11.5523 337.1657	13.3626 2.4439	14.8198 24.5127	16.1364 43.0938	
444.48	13.7145 70.4807	13.9539 86.9785	13.4677 105.0343	12.4010 126.6117	10.3858 152.8850	7.1188 189.1112	3.8567 256.1107	5.4365 336.0115	8.6707 6.2445	10.6728 25.0111	12.1181 40.6994	13.1301 55.5206	
666.72	10.9215 81.0203	10.9859 92.4768	10.4888 104.3052	9.5582 118.0781	7.8155 132.5556	5.2300 143.0829	2.6743 124.8145	3.8326 66.3909	6.6167 34.2370	8.5909 56.6723	9.7168 63.2981	10.4348 71.5852	
888.96	9.6053 87.1413	9.6694 94.5647	9.2892 102.4550	8.4931 110.6453	7.2487 117.6783	5.7794 119.2399	4.8126 108.9361	5.1659 89.7832	6.4914 76.7934	7.7483 73.9729	8.7204 75.8702	9.2900 80.7049	
1111.20	8.8595 91.1103	8.9670 95.7082	8.6451 101.0522	7.8904 106.9456	7.1972 110.0447	6.3312 139.8507	5.7749 103.9515	5.9770 94.0379	6.6945 85.7161	7.4878 82.5210	8.2297 82.8965	8.6605 86.1850	
1333.44	0.0003 0.0003	8.3413 96.8043	8.0934 100.6786	0.0000 0.0000	7.0586 106.5256	6.6526 105.3662	0.0000 0.0000	6.4437 95.4893	6.7644 90.1171	0.0000 0.0000	7.9612 87.1371	8.1287 90.0352	

Figure C9. (Concluded)

Radius from Eye (km)

HOUR 16	0.	30.	60.	90.	120.	150.	180.	210.	240.	270.	300.	330.	
1.85	11.2437	11.4761	10.3044	7.7846	6.1747	3.4501	0.9180	3.5643	5.8231	8.6842	10.4973	11.1527	Speed
	104.4065	119.8523	134.7001	155.9167	178.8932	200.5628	330.6789	8.4306	36.9258	61.2675	71.1910	86.3555	Direction
3.70	17.6475	17.3363	16.3296	14.6679	12.6388	10.8949	9.8741	9.9159	11.3789	13.3953	15.2323	16.8249	
	94.1117	115.7198	138.5485	164.2100	193.5205	228.4638	270.6390	314.4968	352.8335	24.0531	49.9509	72.6209	
5.56	22.1716	22.0421	20.9525	19.3236	17.2950	15.5376	14.6109	14.3302	15.1942	17.1555	19.2036	20.9901	
	91.8003	115.0607	139.1991	166.0622	195.6106	228.7250	265.7280	304.0561	341.0821	14.1527	42.9448	68.2491	
7.41	25.2356	25.3759	24.3093	22.4571	20.4302	18.5694	17.3412	17.0477	17.7657	19.5743	21.8980	23.9225	
	91.6391	115.3001	139.5770	166.5271	196.0433	228.2913	263.9250	300.8007	337.2375	11.4333	41.1243	67.3070	
9.26	27.4713	27.7923	26.6912	24.6330	22.3512	20.2380	18.8626	18.5377	19.2863	21.1638	23.6550	25.9655	
	91.7173	114.9957	139.3335	155.7586	195.0855	227.8562	263.2246	299.7166	336.6582	10.7084	40.7505	67.5752	
11.11	29.1225	29.5067	28.4123	26.1495	23.4336	21.0612	19.6221	19.3092	20.2181	22.2773	24.9198	27.4068	
	91.2803	114.1235	137.7406	164.0796	193.6250	226.8195	263.0509	300.2320	336.7486	10.8201	40.9584	67.3522	
12.96	30.2401	30.6214	29.5192	27.1356	24.0444	21.3686	19.8898	19.7099	20.8690	23.0992	25.8349	28.4076	
	90.3642	112.6070	135.7348	161.8877	191.6154	225.7869	263.2420	301.2206	337.5411	11.0479	40.7868	66.8027	
14.82	30.0333	31.1804	30.0544	27.6361	24.3028	21.3039	19.8231	19.0700	21.3363	23.7362	26.4579	28.9790	
	89.1661	110.9763	133.7117	159.6136	189.4433	224.7087	263.8284	302.6944	338.8593	11.3844	40.3605	65.9983	
16.67	30.9363	31.2995	30.1248	27.6749	24.3093	20.9899	19.4328	19.9176	21.7478	24.2775	26.0784	29.2075	
	88.0717	109.6573	132.0880	157.6458	18[illegible].4785	223.7131	264.7399	304.6505	340.6691	11.9460	39.8689	65.1336	
18.52	30.6512	31.0731	29.8138	27.3308	24.0747	20.4539	18.9392	19.8871	22.1634	24.8445	27.1478	29.1802	
	87.3863	108.8247	131.1787	156.3051	185.8688	223.0573	266.1380	307.0577	342.9109	12.8890	39.5189	64.5458	
27.78	30.3617	29.4271	27.9424	25.1578	21.4511	17.9408	17.6164	21.5914	27.3583	31.6220	33.0507	32.0244	
	89.1691	112.2728	134.8369	158.9907	188.3302	229.2735	279.9315	322.6047	351.8723	14.2909	36.9171	62.3394	
37.04	37.1555	32.8482	29.8507	25.9423	21.2231	19.2930	21.3585	29.0146	35.6894	39.8401	42.5503	41.7294	
	76.1392	113.4939	140.5225	157.5576	201.0117	243.3482	289.0320	322.8142	338.0859	356.6950	16.6785	42.5907	
46.30	43.6332	41.5019	37.0923	32.1996	28.2942	28.1506	30.7386	36.4357	39.8717	41.6286	44.8064	44.5509	
	57.5135	92.9338	130.2828	155.1445	202.1307	237.9048	271.4577	296.0308	316.1778	340.0486	2.2253	27.7181	
55.56	45.2505	44.6212	41.6396	38.2286	36.1424	35.5101	36.7592	38.8504	40.1942	41.6717	43.3627	44.2556	
	48.0145	79.7853	116.2939	154.4880	189.6841	222.5149	253.2397	278.8506	304.2949	330.3460	354.9935	20.6167	
74.08	41.7476	42.1196	41.0181	39.2676	38.0387	36.3744	35.7323	36.2801	36.6486	37.8418	39.5037	40.6004	
	42.5465	71.8083	103.8438	139.1621	173.6022	206.3804	238.5726	268.0639	296.6426	324.1752	350.5375	16.2282	
92.60	37.2312	37.4994	36.9212	35.5824	33.7248	32.1302	31.4307	31.3324	31.0627	33.1926	34.5990	35.9117	
	42.6775	70.7075	100.8417	135.0267	169.0215	202.7459	236.2374	266.8992	296.6611	324.9866	351.4562	16.8457	
111.12	33.0564	33.3790	32.9237	31.7381	29.7350	28.0402	27.2613	27.0360	27.6501	28.9668	30.3893	31.7591	
	44.3073	71.4830	100.7526	133.6174	168.0328	202.6438	236.9269	268.8583	299.4995	327.9138	354.3301	19.4809	
138.90	28.1503	28.5594	28.1347	26.9237	24.8545	22.9869	22.0139	21.9838	22.6717	24.0334	25.6173	26.9531	
	47.5702	73.8682	101.3118	132.8400	168.3913	203.3250	239.5307	274.0621	304.8939	333.5317	359.9588	23.8199	
166.68	24.6793	24.9877	24.5544	23.4583	21.1613	19.1054	18.1550	18.1680	19.0297	20.5807	22.1071	23.4964	
	50.8242	75.9279	102.4551	132.5715	168.0828	204.6216	242.5515	279.5340	311.3866	339.4410	5.3503	28.4697	

Azimuth (deg)

Figure C10. Wind speed and direction fields, Snapshot 9, Hurricane Gilbert (Continued)

Radius from Eye (km)	Azimuth (deg)												
222.24	19.9563 57.6513	20.3481 79.9810	19.8652 104.3972	18.7060 132.9872	16.3530 166.6655	14.0355 206.9336	12.9329 251.8312	13.1464 291.6588	14.4707 325.5378	16.1756 352.6827	17.6736 15.8158	19.1063 37.8246	Speed Direction
333.36	15.4283 66.8263	15.6706 86.0111	15.1135 106.2282	14.0677 130.5753	11.7996 160.9316	8.9986 199.9198	6.4878 260.0677	7.8123 320.2440	10.1337 352.3451	12.0652 14.4297	13.5989 33.7948	14.7648 50.1592	
444.48	13.1323 74.1125	13.3257 89.7195	12.7691 106.6535	11.6796 127.0406	9.6835 151.2855	6.3206 182.6228	2.3434 245.9375	4.4607 354.3451	8.0136 17.8044	10.1799 33.0926	11.6522 46.5315	12.5701 59.9190	
666.72	10.9333 82.1863	10.9990 93.6273	10.4790 105.4309	9.5330 119.0760	7.8200 133.5331	5.3051 144.1448	2.8301 129.8587	3.6343 72.3699	6.4186 56.9675	8.4980 58.3093	9.7137 64.3260	10.4552 72.5259	
888.96	9.7377 87.2262	9.8526 95.2725	9.4422 103.7860	8.6238 112.7698	7.2931 120.7818	5.6923 123.3870	4.5490 112.8323	4.8463 90.9422	6.3113 76.0686	7.7488 72.8333	8.8481 74.9080	9.4528 80.1716	
1111.20	9.0854 90.7525	9.1855 96.2881	8.8507 102.5408	8.0046 109.3689	7.1897 113.5631	6.1504 113.9000	5.4627 107.0344	5.6353 94.7669	6.5006 84.5543	7.4789 80.7419	8.3627 81.3692	8.8597 85.1539	
1333.44	0.0003 0.0003	8.6081 97.2023	8.2771 102.1143	0.0000 0.0000	7.0213 109.7446	6.4374 108.9660	0.0000 0.0000	6.1209 96.2094	6.5714 88.9266	0.0000 0.0000	8.0732 85.5795	8.3444 88.7696	

Figure C10. (Concluded)

HOUR 18	0.	30.	60.	90.	120.	150.	180.	210.	240.	270.	300.	330.	
					Azimuth (deg)								
1.85	5.8791	5.8152	5.7581	5.7244	5.7350	5.7720	5.8250	5.8780	5.9223	5.9468	5.9644	5.9408	Speed
	104.9437	105.1008	104.6491	103.6973	102.8480	102.0790	101.6304	101.6966	102.1501	102.8366	103.7457	104.5127	Direction
3.70	6.0385	5.8556	5.6875	5.6053	5.6093	5.6977	5.8239	5.9208	6.0187	6.0952	6.1677	6.1779	
	107.2986	107.7660	107.0980	105.3896	103.4183	101.3651	100.3555	100.4585	101.0648	102.4782	104.1249	105.9610	
5.56	6.6052	6.2755	5.8683	5.4957	5.2914	5.2809	5.5704	5.6918	5.9782	6.3115	6.6404	6.8159	
	109.5692	112.4100	113.8568	111.2792	108.6707	104.0910	100.2331	98.5569	97.6445	99.6729	101.8262	105.3813	
7.41	8.1022	7.5052	6.7850	5.8232	4.8050	4.0650	3.9326	4.6831	5.6382	6.6329	7.5069	8.1191	
	108.7143	117.0380	124.8834	128.6930	125.8730	116.1497	102.1179	91.8850	86.6838	87.8724	93.8237	100.7331	
9.26	10.3157	9.8030	9.0202	7.4588	5.1709	2.8452	0.9344	3.0886	5.4814	7.6819	9.2662	10.1204	
	105.0439	119.8488	134.0343	148.4417	160.6423	166.1832	108.8375	56.7296	58.3870	67.3143	79.8284	91.5931	
11.11	12.8764	12.5065	11.6449	10.1485	7.8619	5.0521	2.3729	4.1879	7.2315	9.7813	11.5386	12.6221	
	101.4369	120.0983	139.7015	160.4014	184.9847	217.7013	277.3377	353.9601	26.7457	47.6170	65.9497	83.5906	
12.96	15.6671	15.4080	14.5311	13.0503	11.1056	8.8946	6.9756	7.6180	9.9707	12.2262	14.1036	15.2993	
	98.6277	119.9611	142.3654	166.3539	193.9777	229.0041	276.8531	329.7876	7.5710	34.4939	56.9631	77.8704	
14.82	18.6273	18.5315	17.6727	16.1341	14.1814	11.9965	10.4365	10.7774	12.5248	14.7444	16.8134	18.1419	
	96.8716	119.8137	143.2739	168.6552	197.0950	230.8480	273.6295	319.2888	357.2503	26.5178	51.1586	74.1466	
16.67	21.6328	21.7028	20.8665	19.2667	17.1703	14.6755	13.1134	13.2873	14.8966	17.2690	19.5127	21.0834	
	95.6203	119.5404	143.3201	169.1813	197.4688	230.5236	271.3225	314.0738	351.4125	21.6671	47.7105	71.7587	
18.52	24.6101	24.8284	23.9246	22.1237	19.8816	17.0101	15.2121	15.4523	17.1371	19.7091	22.1439	23.8249	
	94.2873	118.8821	142.3074	168.3827	196.9388	229.3966	269.4473	310.9637	348.0617	18.8115	45.5671	69.9539	
27.78	35.5229	34.8410	32.9125	30.1479	26.6152	23.1143	21.6590	23.1548	26.7359	30.7058	33.6706	34.9819	
	85.5987	109.6270	135.0929	162.8338	192.8734	228.5839	270.0502	310.5603	344.5555	12.5334	37.2657	61.2740	
37.04	39.3955	37.7291	34.9978	31.6346	28.3559	25.4676	25.7373	29.8866	34.5245	38.4115	40.0783	40.6728	
	77.1824	103.4319	130.2106	160.2411	193.7711	232.4536	274.7835	311.6036	338.5124	2.1760	25.5847	50.4634	
46.30	40.9423	38.2838	34.9545	31.4693	28.3984	27.0173	29.2189	34.1790	37.8622	40.6875	42.5411	42.6448	
	70.6902	99.7451	128.8806	160.7063	196.4046	236.4919	275.4991	305.8599	329.1547	352.0350	15.1297	41.1493	
55.56	41.7935	39.0205	35.0911	31.3828	28.7288	28.6614	31.8745	35.6987	38.5344	40.8439	42.3466	42.0135	
	64.9161	96.4601	120.4886	162.2876	199.1939	230.6906	273.2154	299.1044	322.4314	345.5880	8.7131	34.8333	
..08	41.0643	40.1197	36.2898	32.2104	30.3981	30.8071	32.9192	35.1327	36.8094	38.3970	40.2096	40.9471	
	55.4141	87.4422	122.7576	160.1244	190.9555	233.5296	263.1399	288.0832	313.5711	338.4441	2.2220	27.4732	
92.60	39.5187	39.0413	36.7864	33.5399	31.6988	31.2726	31.9372	33.3089	34.6699	36.1576	37.7727	38.7348	
	50.4203	80.3453	114.2004	151.9942	188.9102	222.8533	254.2651	281.6341	308.0416	334.3213	358.6581	23.6805	
111.12	37.7723	37.6338	36.1561	33.9693	32.0884	30.8858	30.9348	31.7090	32.7453	34.1408	35.7021	36.7082	
	47.5263	76.4333	108.508[illegible]	144.7543	180.4136	215.0646	247.7752	276.7665	304.6755	331.5495	356.6666	22.7737	
138.90	34.7661	34.9129	34.0209	32.4345	30.5914	28.9448	28.3386	28.9649	29.7139	30.9772	32.6236	33.6645	
	46.0253	74.1238	103.8252	137.7684	173.6272	208.1007	242.3351	273.6733	302.5104	330.1435	356.1758	20.8916	
166.68	31.8693	32.0541	31.3974	30.0672	28.2089	26.3365	25.5509	26.0123	26.6729	27.9786	29.5903	30.7129	
	44.3323	73.3764	102.1377	134.6385	169.9289	205.0914	240.4537	272.9054	303.0412	331.0713	357.0790	21.8364	

Radius from Eye (km)

Figure C11. Wind speed and direction fields, Snapshot 10, Hurricane Gilbert (Continued)

Azimuth (deg)

Radius from Eye (km)													
222.24	26.7972 49.3517	27.0216 74.8211	26.5606 101.9207	25.4717 132.7341	23.3488 167.1542	21.4316 203.8656	20.5279 241.5149	20.5820 276.2262	21.5313 308.1366	22.9452 336.5665	24.4360 2.0208	25.7370 26.1352	Speed Direction
333.36	20.2095 56.7752	20.4624 79.8549	19.9481 103.7922	18.9608 131.3617	16.7296 165.2771	14.5110 203.4128	13.2533 247.3598	13.5209 290.4482	14.7728 323.8267	16.4545 351.0950	17.9853 15.2997	19.3449 36.5404	
444.48	16.3593 64.6661	16.6361 84.2963	16.0659 105.5963	14.9938 130.9365	12.8784 161.1408	10.3397 200.8554	8.4210 254.8887	9.8545 308.3550	11.0788 343.9236	13.0173 8.3866	14.4581 28.4901	15.7484 46.7605	
666.72	12.6181 75.7063	12.7210 90.8558	12.1337 106.5368	11.1019 125.2475	9.1712 147.4763	5.8215 174.2476	1.7335 219.7447	3.6621 10.1466	7.4212 26.4106	9.7288 38.4016	11.2113 50.8214	12.8492 62.8601	
888.96	10.7025 83.2494	10.8083 93.8443	10.2993 105.2178	9.3326 117.9366	7.6900 131.2879	5.2976 140.1694	3.1928 125.4241	3.7751 76.8229	6.3481 60.2250	8.3548 60.9334	9.5751 65.9497	10.2830 73.8207	
1111.20	9.6055 88.4553	9.7236 95.6541	9.2984 103.7698	8.3589 113.8098	7.2471 119.6926	5.7635 121.7317	4.6719 111.5364	4.9883 91.2768	6.3158 77.4573	7.6736 74.0587	8.7938 75.9633	9.3019 81.2768	
1333.44	0.0003 0.0003	8.9638 96.9863	8.5638 103.1059	0.0000 0.0004	7.8117 113.2149	6.1609 112.7698	0.0000 0.0000	5.7575 95.1015	6.3997 85.5864	0.0000 0.0000	8.2841 82.4577	8.6668 86.5489	

Figure C11. (Concluded)

HOUR 20 Radius from Eye (km)	0.	30.	60.	90.	120.	150.	180.	210.	240.	270.	300.	330.	
1.85	5.9295 103.3085	5.8823 103.3145	5.8475 102.8789	5.8352 102.1129	5.8551 101.4148	5.8926 100.8360	5.9372 100.5314	5.9747 100.6673	6.0005 101.0966	6.0081 101.6880	6.0052 102.4317	5.9767 103.0237	Speed Direction
3.70	5.9813 105.1683	5.8669 105.2324	5.7664 104.3956	5.7365 102.8508	5.7774 101.3052	5.8698 100.0011	5.9524 99.4394	6.0304 99.6977	6.0758 100.4833	6.1027 101.6783	6.1130 103.0752	6.0821 104.4840	
5.56	6.1633 107.4967	5.9303 108.1465	5.7101 107.1981	5.6101 104.8389	5.6446 102.3313	5.7917 99.8342	5.9305 98.5782	6.0720 98.8351	6.1500 99.7337	6.2274 101.4827	6.3306 103.4341	6.3446 105.6725	
7.41	6.7665 109.5953	6.2669 112.2300	5.7929 113.2055	5.4781 111.5368	5.3447 107.0325	5.4262 101.8920	5.7160 98.8276	5.9119 97.9039	6.1369 97.2748	6.4120 98.7748	6.7301 101.7671	6.9335 105.5405	
9.26	8.2396 109.0837	7.4281 117.8212	6.6725 124.7192	5.7277 129.6361	4.6734 124.8139	4.1552 114.7697	4.0368 100.7397	4.9863 92.4508	5.7371 87.6621	6.7563 87.7368	7.6339 94.8423	8.2045 101.8705	
11.11	10.3923 106.0663	9.7639 120.6708	8.9160 136.2229	7.3604 151.2572	5.1277 164.2487	2.6882 171.8979	0.9307 105.3585	3.1597 58.1291	5.7189 59.4342	7.8680 68.3347	9.4140 80.4002	10.3230 92.6021	
12.96	12.9992 102.9023	12.5085 121.9654	11.6862 142.5287	10.3057 164.0940	8.2092 189.1190	5.3837 221.4341	2.9532 278.4544	4.1778 357.8077	7.4686 29.5649	10.8225 69.3927	11.7933 67.4063	12.8835 84.9384	
14.82	15.9861 100.1397	15.6682 122.1844	14.9280 145.0974	13.6136 159.6170	11.7990 196.5877	9.3829 229.8189	7.0365 277.3311	7.5289 333.6961	10.2768 11.1384	12.6716 36.6484	14.6086 58.4630	15.8056 79.0865	
16.67	19.2397 98.1997	19.2051 121.9331	18.5487 145.4885	17.1954 170.6803	15.1895 198.0125	12.4795 230.6691	10.4149 274.5188	10.6905 323.7882	13.0812 1.6805	15.6478 28.7482	17.7275 52.6490	19.0106 75.1802	
18.52	22.7203 96.4337	22.8847 121.2744	22.2024 144.6894	20.6210 169.9468	18.3616 197.4518	15.0651 229.9230	12.8303 273.2328	13.3016 319.6206	15.9718 356.4006	18.9824 23.9624	21.0070 49.0842	22.3282 72.3806	
27.78	35.7237 87.6465	34.5808 112.8603	32.6709 138.1398	29.9005 165.4177	26.1567 195.4956	22.3295 232.7752	21.4734 277.7592	25.3418 318.3313	31.3325 347.0461	36.2174 10.5687	38.1519 33.9876	37.2980 59.7563	
37.04	42.5253 74.4135	38.9358 107.4924	35.5777 135.9530	32.1298 156.2190	28.8985 200.6117	27.0051 239.9180	29.3277 280.7308	36.4634 311.2416	41.1668 332.4404	44.4855 353.8004	46.7200 16.1769	46.8016 42.6783	
46.30	45.5143 62.9662	42.1673 97.9806	37.5512 133.7469	33.7562 157.7668	31.3806 204.1537	31.7408 240.3868	35.1369 272.9382	39.8362 297.5981	42.5312 319.7523	44.4570 343.5421	46.3933 6.2604	46.8355 32.3419	
55.56	46.0263 55.4423	44.3577 88.5973	39.7155 127.3518	35.9760 165.7419	34.2557 201.6400	34.9786 235.0846	37.6524 263.6334	39.7857 288.0840	41.5712 312.5301	43.2627 337.4359	44.9356 1.1779	45.6601 26.9505	
74.08	43.4193 48.0403	43.4844 77.9856	41.3370 112.0982	38.4435 150.3156	37.4037 185.6884	36.3556 218.4669	36.4592 249.3781	37.6987 276.9476	38.4562 304.1015	39.7570 330.7860	41.6076 355.9180	42.4629 21.3843	
92.60	40.3345 45.4595	40.4022 74.8640	39.4321 105.1505	37.5403 140.8722	35.8956 175.2963	34.4016 209.1969	33.9222 242.3394	34.4175 271.6305	35.1165 300.3736	36.4832 328.1291	37.9806 354.0091	39.1451 19.3104	
111.12	37.0892 44.8895	37.2525 72.7627	36.6285 102.6368	35.3348 136.2499	33.3321 171.0314	31.6798 205.3954	31.0519 239.1719	31.1381 270.1206	31.7849 299.8629	33.1351 327.8306	34.5634 354.2627	35.8075 19.5995	
138.90	32.3885 46.2781	32.7023 73.3987	32.2608 101.4861	31.0368 133.4826	29.0486 169.0202	27.2302 203.3277	26.3502 238.4238	26.4103 271.7739	27.0126 301.9199	28.3199 330.3402	29.8996 357.2231	31.1494 21.7717	
166.68	28.5631 48.6265	28.8026 74.6354	28.4113 101.9119	27.3218 132.6059	25.1778 167.8595	23.1919 203.3952	22.2396 239.7352	22.2691 274.7785	22.9669 306.0963	24.4164 334.4221	25.9638 0.9902	27.2816 25.2034	

Azimuth (deg)

Figure C12. Wind speed and direction fields, Snapshot 11, Hurricane Gilbert (Continued)

Radius from Eye (km)	Azimuth (deg)												
222.24	22.7764 54.7832	23.1301 78.3752	22.7239 103.7114	21.6340 132.8844	19.3665 166.7420	17.1885 205.0479	16.0338 245.8349	16.0998 283.7704	17.2386 317.3061	18.8421 345.6508	20.3654 10.2331	21.7985 33.8207	Speed Direction
333.36	16.6824 65.0345	16.9134 85.3689	16.3922 106.4554	15.3821 131.4219	13.0846 163.2602	10.5121 202.4648	8.7331 256.2711	9.4515 310.2054	11.2719 344.0362	13.1558 8.3469	14.6668 29.5448	15.9346 47.4538	
444.48	13.5337 74.4161	13.7260 90.3811	13.1828 107.7544	12.0916 128.5662	10.0621 153.7168	6.6926 187.7993	3.0949 256.2504	5.0788 346.8997	8.5471 13.8027	10.5809 30.9929	12.0211 45.6138	12.9692 59.7847	
666.72	10.7063 85.1103	10.7060 95.6938	10.2118 106.5426	9.3165 119.0615	7.6233 131.5566	5.2998 139.3376	3.1588 121.8301	4.1276 76.5244	6.6329 62.2259	8.5064 62.9819	9.5773 68.7338	10.2520 76.2879	
888.96	9.3861 91.1683	9.3819 97.5857	9.0390 104.3688	8.2877 111.1915	7.2128 116.6356	5.9841 117.1069	5.2125 108.6331	5.5181 94.1247	6.6458 82.9938	7.7315 80.0907	8.5796 81.4591	9.1143 85.5395	
1111.20	8.5903 94.4785	8.6799 98.4139	8.3925 102.7198	7.7497 107.0723	7.2106 109.5379	6.5444 109.0595	6.1193 104.4529	6.2768 97.2281	6.8785 90.8282	7.5224 88.8055	8.1249 88.2515	8.4628 90.6672	
1333.44	0.0303 0.0003	8.0841 98.8749	7.8979 101.8318	0.0000 0.0000	7.0902 105.9607	6.8455 105.2798	0.0360 0.0360	6.6947 98.2644	6.9574 94.2211	0.0000 0.0000	7.8939 92.0829	7.9547 93.7453	

Figure C12. (Concluded)

Radius from Eye (km)	Azimuth (deg)												
HOUR 22	0.	30.	60.	90.	120.	150.	180.	210.	240.	270.	300.	330.	
1.85	5.8683 106.5002	5.7806 106.7510	5.6997 106.2191	5.6499 105.0235	5.6522 103.9704	5.7040 102.9887	5.7362 102.3549	5.8702 102.3888	5.9370 102.9132	5.9738 103.7604	6.0087 104.9363	5.9708 105.9163	Speed Direction
3.70	6.1945 109.7323	5.9179 110.9312	5.6022 111.0330	5.4067 108.2792	5.3474 105.8942	5.4097 102.6610	5.6592 100.7512	5.8390 100.2132	6.0845 99.9980	6.2573 102.2222	6.4176 104.2608	6.4387 107.3665	
5.56	7.5137 111.0123	7.0523 117.9845	6.3398 124.1789	5.3752 115.0418	4.5785 122.0035	4.0591 111.9417	4.4527 99.8573	5.0094 91.7266	5.8806 88.0898	6.7244 91.8972	7.4401 96.2967	7.8156 103.0074	
7.41	10.1193 107.1554	9.5543 121.7911	8.7735 137.0622	7.1616 150.7317	4.8845 161.4687	2.4381 165.5040	1.1314 92.4304	3.4569 57.9183	5.9578 59.2401	7.9428 68.4480	9.2984 81.1289	10.0938 93.7938	
9.26	13.3121 102.8131	12.9520 122.9756	12.2287 142.0235	10.7793 164.3818	8.4743 190.5141	5.6443 223.8259	3.5525 283.8187	5.1262 352.6953	8.1597 23.0819	10.5079 44.9588	12.1309 65.1506	13.0651 83.6423	
11.11	16.9411 99.6387	16.8812 122.2555	16.2157 145.0753	14.7052 169.1489	12.6338 197.1801	10.2925 231.8822	8.6545 278.4590	9.4547 327.1765	11.5400 3.0855	13.6147 50.7740	15.3609 54.5714	16.4849 77.3848	
12.96	20.7713 98.0183	21.0445 121.6941	20.4157 145.2075	18.8100 170.0977	16.4285 198.0714	13.8330 232.3898	12.3474 274.5128	12.8624 317.7914	14.6487 353.6618	16.8092 22.8793	18.6859 49.0096	19.9808 73.9653	
14.82	24.5265 96.7685	25.1146 120.6180	24.3814 144.0765	22.5829 159.4434	19.8353 197.3929	16.8137 231.2148	15.2182 272.2394	15.7096 313.3688	17.5322 348.8700	19.8480 18.9224	21.8935 46.0263	23.3874 71.7837	
16.67	27.9951 95.1472	28.7738 118.8140	27.7604 142.0742	25.6301 157.7234	22.5747 196.0692	19.1495 230.1030	17.4714 271.0315	18.1192 311.4927	20.1729 346.7214	22.6708 16.8353	24.9213 44.1905	26.5949 69.9429	
18.52	30.8953 92.8013	31.7702 116.4018	30.3424 139.5762	27.7474 155.4955	24.5794 194.5629	20.7928 229.1581	19.0538 270.7348	20.1122 311.1021	22.5434 345.9366	25.3486 15.5027	27.7873 42.7749	29.5115 67.9633	
27.78	37.8815 82.9515	36.5787 107.4056	34.4266 132.8460	31.2468 160.9985	27.2526 192.9456	23.8345 232.6450	23.8599 277.0320	27.7243 315.2740	32.8432 344.0299	37.0638 8.1449	38.9985 31.4698	38.8055 56.6615	
37.04	40.6303 73.7814	37.3980 105.0182	34.2299 132.7246	30.6971 153.0099	27.3107 198.5433	25.6207 240.1823	28.1365 281.5569	34.3422 312.0752	38.5601 333.8206	41.6440 355.1287	43.6306 17.6479	43.2483 43.5732	
46.30	42.3714 64.4125	39.0756 98.4601	34.6418 132.8265	30.7574 166.2447	27.9601 203.7569	28.2714 242.6842	31.8493 276.3382	36.3564 301.1626	39.1003 322.9312	41.1692 346.0280	42.9631 8.5565	43.5302 34.2627	
55.56	42.7425 57.1113	41.0297 89.9770	36.3285 128.0894	32.2254 166.1621	30.0780 203.4587	30.8943 238.7636	33.9292 267.7222	36.2971 291.6683	38.2261 315.5453	39.9984 339.9640	41.6496 3.3077	42.4561 28.7798	
74.08	40.5303 49.1835	40.6559 78.7955	38.4459 112.8468	35.2583 151.3618	34.0633 187.4140	33.0826 220.5939	33.3345 251.5351	34.6161 279.0654	35.4817 306.1276	36.7987 332.7593	38.6883 357.5262	39.5999 22.7743	
92.60	37.6405 66.6213	37.7455 74.8456	36.7535 105.7721	34.7217 141.5890	33.0518 176.2416	31.5190 210.4728	31.0137 244.0720	31.5434 273.4544	32.2956 302.3351	33.6708 330.1503	35.2296 355.6884	36.4328 20.7702	
111.12	34.5017 46.2445	34.7113 73.7065	34.0656 103.3428	32.6936 136.9694	30.6348 171.8706	28.9383 206.7071	28.2838 240.9147	28.3774 272.1779	29.0911 302.1337	30.4606 330.1787	31.9442 356.2542	33.2275 21.3097	
138.90	30.0557 47.9143	30.4096 74.5528	29.9345 102.2921	28.4659 134.1456	26.5958 169.8555	24.7179 204.7141	23.8362 240.5273	23.9003 274.3607	24.5860 304.7552	25.9384 333.2265	27.5578 359.7035	28.8423 23.8430	
166.68	26.5042 50.4445	26.7982 75.9031	26.3680 102.7452	25.2436 133.1483	23.0158 168.5574	20.9518 204.7376	19.9141 242.8393	20.0596 277.9359	20.8546 309.5143	22.3384 337.7746	23.9371 3.8764	25.2852 27.5431	

Figure C13. Wind speed and direction fields, Snapshot 12, Hurricane Gilbert (Continued)

Azimuth (deg)

Radius from Eye (km)													
222.24	21.2642 56.7867	21.6436 79.6663	21.2031 104.4285	20.0824 133.1846	17.7597 166.8934	15.4786 236.1586	14.3326 248.8341	14.4726 288.1352	15.7158 321.9060	17.3848 349.7544	18.9052 13.6237	20.3482 35.6282	Speed Direction
333.36	15.8521 66.8981	16.0818 86.4163	15.5516 106.7736	14.5325 131.0914	12.2563 161.8558	9.5366 200.9201	7.2402 258.7548	8.3949 317.1211	10.5082 350.0761	12.4397 13.0018	13.9458 33.1369	15.1384 50.0034	
444.48	13.0766 75.7189	13.2574 91.0077	12.7148 107.6061	11.6307 127.4948	9.6498 151.4050	6.2261 182.4662	2.2184 247.9109	4.5313 357.1548	8.0867 19.9131	10.2010 35.1326	11.6192 48.4571	12.5173 61.7384	
666.72	10.5345 85.6181	10.5369 95.7673	10.0607 106.1711	9.1900 118.0792	7.5507 129.6998	5.3766 136.4057	3.4547 120.4382	4.2284 80.5949	6.5566 65.2061	8.3439 64.9329	9.4281 70.0051	10.0925 77.1232	
888.96	9.3353 91.1823	9.3324 97.4677	8.9984 104.1113	8.2584 110.7762	7.2139 116.0412	6.0248 116.4920	5.2725 108.4391	5.5444 94.6155	6.6171 83.6558	7.6791 80.5457	8.5196 81.7418	9.0636 85.6730	
1111.20	8.5833 94.3025	8.6750 98.2470	8.3883 102.5801	7.7470 106.9674	7.2093 109.4575	6.5425 139.0239	6.1128 104.4556	6.2589 97.2536	6.8518 90.7928	7.4971 87.8202	8.1059 88.0696	8.4499 90.4770	
1333.44	0.0003 0.0003	8.1000 98.7140	7.9080 101.7670	0.0000 0.0000	7.0822 106.0685	6.8234 105.3944	0.0000 0.0000	6.6594 98.1342	6.9270 93.9849	0.0000 0.0000	7.8881 91.7188	7.9624 93.4308	

Figure C13. (Concluded)

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$ ASSIGN GILB.WIND21 FOR020
$ ASSIGN GILB.WIND18 FOR018
$ RUN AZIM_AVER
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Radius (n.m.)	Radius (km)	--- Wind Speed --- Scalar Avg. (m/sec)	Vector Avg. (m/sec)	Inflow Angle, (+ = in, - = out) (deg)	
WIND,HOUR		20	0		
1.	1.852	5.9405	0.0583	242.9772	
2.	3.704	5.9437	0.1176	243.5015	Snapshot 1
3.	5.556	5.9498	0.1792	244.4844	
4.	7.408	5.9595	0.2443	245.8895	
5.	9.260	5.9755	0.3159	248.0143	
6.	11.112	6.0049	0.4017	251.6257	
7.	12.964	6.0747	0.5263	259.0292	
8.	14.816	6.2682	0.7831	-85.1015	
9.	16.668	6.7906	1.4971	-61.3046	
10.	18.520	7.8736	3.2177	-39.8814	
15.	27.780	26.7127	25.8542	0.0638	
20.	37.040	38.1360	37.0043	14.4071	
25.	46.300	39.8450	38.6980	21.4880	
30.	55.560	39.2075	38.2327	26.3533	
40.	74.080	36.9664	36.4542	35.2711	
50.	92.600	34.7457	34.4134	40.8962	
60.	111.120	32.1222	31.8455	43.3617	
75.	138.900	27.6395	27.3607	43.5430	
90.	166.680	23.5362	23.2120	41.9649	
120.	222.240	17.3512	16.8293	36.0960	
180.	333.360	10.8521	9.6021	23.6111	
240.	444.480	7.9560	5.4558	15.0186	
360.	666.720	7.4514	1.7981	10.4387	
480.	888.960	7.4233	0.6930	11.4414	
600.	1111.200	7.4100	0.3141	6.7318	
720.	1333.440	6.9126	0.1089	-12.1050	
WIND,HOUR		20	1		
1.	1.852	5.9644	0.0565	240.5800	Interpolation between Snapshots 1 & 2
2.	3.704	5.9677	0.1138	241.0424	
3.	5.556	5.9738	0.1730	241.9138	
4.	7.408	5.9834	0.2350	243.1496	
5.	9.260	5.9985	0.3022	245.0328	
6.	11.112	6.0250	0.3803	248.1936	
7.	12.964	6.0830	0.4864	254.5270	
8.	14.816	6.2368	0.6847	266.6367	
9.	16.668	6.6499	1.2092	-68.0856	
10.	18.520	7.5427	2.5093	-45.4020	
15.	27.780	23.5379	22.5697	-2.4338	
20.	37.040	38.3208	37.1779	14.3704	
25.	46.300	42.0500	41.0345	23.7352	
30.	55.560	41.5028	40.6994	29.0430	
40.	74.080	37.9929	37.5078	35.4472	
50.	92.600	34.9229	34.5727	39.4681	
60.	111.120	32.1931	31.8974	41.7054	
75.	138.900	28.1118	27.8268	42.5412	
90.	166.680	24.3038	23.9868	41.6276	
120.	222.240	18.2532	17.7728	36.8113	
180.	333.360	11.5444	10.4276	25.1562	
240.	444.480	8.2821	6.0906	16.3304	
360.	666.720	7.4668	2.0921	10.6132	
480.	888.960	7.4237	0.8189	11.3544	
600.	1111.200	7.4093	0.3746	7.6189	
720.	1333.440	6.9128	0.1289	-8.0063	

Figure C14. Azimuthally averaged speed and inflow angle, Hurricane Gilbert (Sheet 1 of 12)

Radius (n.m.)	Radius (km)	— Wind Speed — Scalar Avg. (m/sec)	Vector Avg. (m/sec)	Inflow Angle, (+ = in, - = out) (deg)	
WIND,HOUR		20	2		
1.	1.852	5.9885	0.0548	238.0248	
2.	3.704	5.9919	0.1102	238.4156	Snapshot 2
3.	5.556	5.9982	0.1672	239.1560	
4.	7.408	6.0076	0.2264	240.1999	
5.	9.260	6.0220	0.2895	241.7764	
6.	11.112	6.0457	0.3604	244.3654	
7.	12.964	6.0921	0.4500	249.2603	
8.	14.816	6.2074	0.5968	260.4110	
9.	16.668	6.5173	0.9457	-78.7729	
10.	18.520	7.2460	1.8151	-55.4724	
15.	27.780	20.4553	19.1466	-5.2852	
20.	37.040	33.5064	37.3467	14.3384	
25.	46.300	44.2971	43.3895	25.7404	
30.	55.560	43.8676	43.1995	31.4260	
40.	74.080	39.0180	38.5573	35.6167	
50.	92.600	35.1224	34.7513	38.0579	
60.	111.120	32.2916	31.9735	40.0499	
75.	138.900	28.5935	28.3006	41.5780	
90.	166.680	25.0731	24.7614	41.3158	
120.	222.240	19.1630	18.7172	37.4373	
180.	333.360	12.2446	11.2392	26.5320	
240.	444.480	8.6870	6.7227	17.4240	
360.	666.720	7.4862	2.3823	10.7169	
480.	888.960	7.4253	0.9447	11.2861	
600.	1111.200	7.4090	0.4350	8.2587	
720.	1333.440	4.9130	0.1493	-5.0173	
WIND,HOUR		20	3		
1.	1.852	5.8402	0.7731	-75.1767	Interpolation between Snapshots 2 & 3
2.	3.704	6.4599	3.0543	-50.1969	
3.	5.556	9.9973	8.7711	-22.2437	
4.	7.408	17.1276	16.4325	-8.7850	
5.	9.260	23.7617	23.2580	-1.7680	
6.	11.112	27.9470	27.5536	2.6972	
7.	12.964	29.9794	29.6319	6.0785	
8.	14.816	30.5931	30.2645	8.6527	
9.	16.668	30.4137	30.1121	10.4360	
10.	18.520	29.9044	29.6449	11.3989	
15.	27.780	33.3389	32.9973	10.4108	
20.	37.040	39.8700	38.9509	15.7391	
25.	46.300	40.8779	39.9576	22.2504	
30.	55.560	39.5400	38.7501	26.6865	
40.	74.080	35.3129	35.8119	33.3749	
50.	92.600	33.4908	33.1396	37.8682	
60.	111.120	30.9005	30.6016	40.2691	
75.	138.900	27.0636	26.7709	41.2536	
90.	166.680	23.5050	23.1748	40.4313	
120.	222.240	17.8497	17.3439	35.7290	
180.	333.360	11.4874	10.3226	24.5473	
240.	444.480	8.3587	6.1182	16.4950	
360.	666.720	7.5436	2.1977	11.5892	
480.	888.960	7.4797	0.9074	12.1303	
600.	1111.200	7.4515	0.4313	9.1300	
720.	1333.440	4.9283	0.1473	-3.2691	

Figure C14. (Sheet 2 of 12)

Radius (n.m.)	Radius (km)	--- Wind Speed --- Scalar Avg. (m/sec)	Vector Avg. (m/sec)	Inflow Angle, (+ = in, - = out) (deg)	
WIND,HOUR		20	4		
1.	1.852	5.8323	1.5088	-73.7257	
2.	3.704	7.6811	5.8655	-48.3018	Snapshot 3
3.	5.556	17.0601	16.3827	-18.8441	
4.	7.408	31.1340	30.6660	-5.6326	
5.	9.260	44.1059	43.7016	1.0484	
6.	11.112	52.0694	51.6435	5.5470	
7.	12.964	55.7219	55.1891	8.9149	
8.	14.816	56.9171	56.2661	11.6026	
9.	16.668	56.6530	55.9352	13.6930	
10.	18.520	55.4595	54.7346	15.2657	
15.	27.780	47.2739	46.6246	17.3370	
20.	37.040	41.2928	40.5148	17.0706	
25.	46.300	37.5578	36.6132	18.1008	
30.	55.560	35.4703	34.4779	20.7272	
40.	74.080	33.6395	33.0831	30.7598	
50.	92.600	31.8519	31.5189	37.6681	
60.	111.120	29.5078	29.2248	40.5194	
75.	138.900	25.5316	25.2342	40.8956	
90.	166.680	21.9416	21.5849	39.4102	
120.	222.240	16.5657	15.9818	33.7018	
180.	333.360	10.7602	9.3951	22.2764	
240.	444.480	3.1825	5.5112	15.3905	
360.	666.720	7.6131	2.0124	12.5970	
480.	888.960	7.5401	0.8702	13.0439	
600.	1111.200	7.4989	0.4276	10.0139	
720.	1333.440	4.9463	0.1454	-1.4962	
WIND,HOUR		20	5		
1.	1.852	5.2252	2.7628	-65.8165	Interpolation between Snapshots 3 & 4
2.	3.704	10.8849	9.7729	-34.6276	
3.	5.556	23.9177	23.3696	-10.5852	
4.	7.408	38.7603	38.3208	-0.9444	
5.	9.260	49.6471	49.2128	4.1015	
6.	11.112	55.1260	54.6246	7.4212	
7.	12.964	57.2447	56.6338	9.9296	
8.	14.816	57.5303	56.8154	11.9629	
9.	16.668	56.7618	55.9895	13.5702	
10.	18.520	55.3013	54.5162	14.8087	
15.	27.780	47.1459	46.3588	16.6690	
20.	37.040	41.7828	40.8349	17.7450	
25.	46.300	38.5645	37.6181	21.1510	
30.	55.560	36.6946	35.9205	25.7857	
40.	74.080	34.4778	34.0738	35.2891	
50.	92.600	31.8423	31.5568	40.0867	
60.	111.120	28.8347	28.5661	41.5009	
75.	138.900	24.3943	24.0850	40.6504	
90.	166.680	20.6857	20.2947	38.4191	
120.	222.240	15.4411	14.7694	31.7297	
180.	333.360	10.0126	8.4136	20.0608	
240.	444.480	3.0213	4.8038	13.9735	
360.	666.720	7.6176	1.7291	12.1352	
480.	888.960	7.5582	0.7501	12.4990	
600.	1111.200	7.5163	0.3689	9.0158	
720.	1333.440	4.9548	0.1238	-3.6095	

Figure C14. (Sheet 3 of 12)

Radius (n.m.)	Radius (km)	--- Wind Speed --- Scalar Avg. (m/sec)	Vector Avg. (m/sec)	Inflow Angle, (+ = in, - = out) (deg)	
WIND,HOUR		20	6		
1.	1.852	5.7256	3.9907	-62.4913	Snapshot 4
2.	3.704	14.5032	13.6544	-28.3991	
3.	5.556	30.8972	30.3899	-6.2408	
4.	7.408	45.3251	45.8593	2.2482	
5.	9.260	54.9773	54.4563	6.4809	
6.	11.112	58.0636	57.4492	9.0340	
7.	12.964	53.7361	58.0230	10.8773	
8.	14.816	53.1499	57.3589	12.3154	
9.	16.668	55.8714	56.0365	13.4475	
10.	18.520	55.1522	54.2988	14.3488	
15.	27.780	47.0437	46.0940	15.9946	
20.	37.040	42.3020	41.1548	18.4114	
25.	46.300	39.6646	38.7001	24.0330	
30.	55.560	33.1960	37.5633	30.4291	
40.	74.080	35.5348	35.2260	39.5457	
50.	92.600	31.8955	31.6439	42.5023	
60.	111.120	28.1750	27.9150	42.5365	
75.	138.900	23.2591	22.9323	40.3630	
90.	166.680	19.4405	19.0049	37.2775	
120.	222.240	14.3366	13.5521	29.3917	
180.	333.360	9.3352	7.4333	17.3851	
240.	444.480	7.9289	4.0952	12.1178	
360.	666.720	7.6295	1.4431	11.4411	
480.	888.960	7.5789	0.6301	11.7383	
600.	1111.200	7.5351	0.3103	7.6245	
720.	1333.440	4.9639	0.1025	-6.6188	
WIND,HOUR		20	7		
1.	1.852	5.8491	4.5236	-58.1521	Interpolation between Snapshots 4 & 5
2.	3.704	15.3031	13.0616	-22.8319	
3.	5.556	31.6745	31.1321	-4.0379	
4.	7.408	45.2941	44.7367	3.0175	
5.	9.260	52.8056	52.1772	6.3979	
6.	11.112	55.6764	54.9776	8.3532	
7.	12.964	56.5360	55.7612	9.8517	
8.	14.816	55.2909	55.4289	11.1628	
9.	16.668	55.4900	54.5386	12.3841	
10.	18.520	54.2968	53.2621	13.5252	
15.	27.780	48.6838	47.4276	18.2287	
20.	37.040	45.1281	44.1740	25.3132	
25.	46.300	42.5121	41.9100	32.3032	
30.	55.560	40.5284	40.1261	37.4110	
40.	74.080	35.1586	35.9069	42.6494	
50.	92.600	31.4613	31.2270	43.5405	
60.	111.120	27.2626	27.0013	42.3935	
75.	138.900	22.2634	21.9178	39.4404	
90.	166.680	18.5853	18.1153	35.9769	
120.	222.240	13.8112	12.9681	27.9865	
180.	333.360	9.1801	7.2034	16.8972	
240.	444.480	7.9265	4.0666	12.5087	
360.	666.720	7.6258	1.5307	12.1834	
480.	888.960	7.5713	0.7078	12.4845	
600.	1111.200	7.5267	0.3684	8.9790	
720.	1333.440	4.9587	0.1301	-2.1435	

Figure C14. (Sheet 4 of 12)

Radius (n.m.)	Radius (km)	--- Wind Speed --- Scalar Avg. (m/sec)	Vector Avg. (m/sec)	Inflow Angle, (+ = in, - = out) (deg)	
WIND,HOUR		20	8		
1.	1.852	7.0426	5.0716	-54.7408	
2.	3.704	17.1757	16.5115	-18.2037	**Snapshot 5**
3.	5.556	32.4857	31.9070	-1.9445	
4.	7.408	44.2867	43.6128	3.8353	
5.	9.260	50.5559	49.7581	6.2712	
6.	11.112	53.2640	52.4012	7.5746	
7.	12.964	54.2964	53.3844	8.7047	
8.	14.816	54.4636	53.4694	9.9306	
9.	16.668	54.1409	53.0254	11.2704	
10.	18.520	53.4684	52.2117	12.6752	
15.	27.780	50.3944	48.7947	20.3304	
20.	37.040	48.4448	47.5966	31.2649	
25.	46.300	46.0761	45.6723	39.2970	
30.	55.560	43.3528	43.0839	43.4863	
40.	74.080	36.8795	36.6723	45.6317	
50.	92.600	31.0389	30.8200	44.6116	
60.	111.120	26.3489	26.0853	42.2429	
75.	138.900	21.2724	20.9049	38.3987	
90.	166.680	17.7416	17.2313	34.5203	
120.	222.240	13.2931	12.3823	26.4577	
180.	333.360	9.0301	6.9736	16.3809	
240.	444.480	7.9248	4.0382	12.9052	
360.	666.720	7.6209	1.6167	12.8425	
480.	888.960	7.5641	0.7856	13.0809	
600.	1111.200	7.5185	0.4267	9.9572	
720.	1333.440	6.9536	0.1582	0.7499	
WIND,HOUR		20	9		
1.	1.852	6.9981	5.0795	-54.8159	**Interpolation between**
2.	3.704	17.1768	16.5351	-18.2056	**Snapshots 5 & 6**
3.	5.556	32.5058	31.9429	-1.9150	
4.	7.408	44.2801	43.6174	3.8725	
5.	9.260	50.4746	49.6803	6.2548	
6.	11.112	53.1378	52.2742	7.4287	
7.	12.964	54.1663	53.2625	8.4029	
8.	14.816	54.3547	53.3862	9.4955	
9.	16.668	54.0787	53.0050	10.7557	
10.	18.520	53.4631	52.2558	12.1347	
15.	27.780	50.7277	49.1375	19.9558	
20.	37.040	49.0489	48.2190	31.2943	
25.	46.300	46.7582	46.3703	39.4880	
30.	55.560	44.0145	43.7565	43.6872	
40.	74.080	37.4074	37.2072	45.7600	
50.	92.600	31.4470	31.2338	44.6763	
60.	111.120	26.6654	26.4072	42.2520	
75.	138.900	21.4959	21.1338	38.3407	
90.	166.680	17.9024	17.3978	34.4100	
120.	222.240	13.3829	12.4762	26.2241	
180.	333.360	9.0683	7.0029	15.9467	
240.	444.480	7.9528	4.0419	12.4316	
360.	666.720	7.6355	1.6109	12.3296	
480.	888.960	7.5744	0.7805	12.4548	
600.	1111.200	7.5258	0.4218	9.4619	
720.	1333.440	6.9565	0.1548	0.8799	

Figure C14. (Sheet 5 of 12)

Radius (n.m.)	Radius (km)	--- Wind Speed --- Scaler Avg. (m/sec)	Vector Avg. (m/sec)	Inflow Angle, (+ = in, - = out) (deg)	
WIND,HOUR		20	10		
1.	1.852	6.9537	5.0869	-54.8961	
2.	3.704	17.1782	16.5585	-18.2091	**Snapshot 6**
3.	5.556	32.5267	31.9786	-1.8853	
4.	7.408	44.2750	43.6215	3.9100	
5.	9.260	50.3961	49.6013	6.2389	
6.	11.112	53.0167	52.1447	7.2816	
7.	12.964	54.0441	53.1380	8.0985	
8.	14.816	54.2563	53.3016	9.0584	
9.	16.668	54.0279	52.9847	10.2410	
10.	18.520	53.4681	52.3011	11.5963	
15.	27.780	51.0640	49.4815	19.5878	
20.	37.040	49.6522	48.8398	31.3240	
25.	46.300	47.4393	47.0666	39.6742	
30.	55.560	44.6752	44.4276	43.8827	
40.	74.080	37.9347	37.7411	45.8854	
50.	92.600	31.8548	31.6470	44.7400	
60.	111.120	26.9819	26.7288	42.2611	
75.	138.900	21.7196	21.3627	38.2847	
90.	166.680	18.0638	17.5646	34.3006	
120.	222.240	13.4730	12.5704	25.9949	
180.	333.360	9.1069	7.0325	15.5172	
240.	444.480	7.9816	4.0458	11.9602	
360.	666.720	7.6511	1.6052	11.8140	
480.	888.960	7.5856	0.7755	11.8209	
600.	1111.200	7.5338	0.4170	8.9545	
720.	1333.440	4.9598	0.1515	1.0131	
WIND,HOUR		20	11		
1.	1.852	8.7207	7.8357	-13.2877	
2.	3.704	16.9519	16.5147	-6.2784	**Interpolation between Snapshots 6 & 7**
3.	5.556	26.1567	25.7571	0.5053	
4.	7.408	32.9936	32.5674	3.7029	
5.	9.260	36.6307	36.1683	5.0808	
6.	11.112	38.3153	37.6633	5.7924	
7.	12.964	39.0787	38.6623	6.5059	
8.	14.816	39.2626	38.8826	7.4000	
9.	16.668	39.0661	38.7132	8.4502	
10.	18.520	38.5591	38.2241	9.5350	
15.	27.780	36.5052	36.1724	13.9470	
20.	37.040	36.8351	36.5306	20.8314	
25.	46.300	38.2610	37.9182	28.2281	
30.	55.560	39.2255	38.8999	34.0331	
40.	74.080	36.8223	36.6041	40.1687	
50.	92.600	32.2816	32.0769	41.0231	
60.	111.120	28.2033	27.9708	39.6747	
75.	138.900	23.4524	23.1454	36.7160	
90.	166.680	20.0079	19.6021	33.6159	
120.	222.240	15.5677	14.8986	27.1520	
180.	333.360	11.1093	9.7741	18.8237	
240.	444.480	8.9368	6.8459	15.5806	
360.	666.720	7.8636	3.9343	14.4370	
480.	888.960	7.6628	2.5745	14.8996	
600.	1111.200	7.5550	1.8281	14.1238	
720.	1333.440	4.9576	0.9003	12.5738	

Figure C14. (Sheet 6 of 12)

Radius (n.m.)	Radius (km)	--- Wind Speed --- Scalar Avg. (m/sec)	Vector Avg. (m/sec)	Inflow Angle, (+ = in, - = out) (deg)	
WIND,HOUR		20	12		
1.	1.852	12.3410	11.8551	3.7061	
2.	3.704	17.3732	17.0704	5.5010	**Snapshot 7**
3.	5.556	19.8249	19.5672	4.8894	
4.	7.408	21.3645	21.1058	4.0851	
5.	9.260	22.3264	22.0409	3.5390	
6.	11.112	22.9808	22.6516	3.4733	
7.	12.964	23.4277	23.0439	3.8438	
8.	14.816	23.6688	23.2223	4.4869	
9.	16.668	23.7225	23.2100	5.1796	
10.	18.520	23.5859	23.0055	5.6476	
15.	27.780	23.2624	22.4453	1.8611	
20.	37.040	25.1342	25.5009	0.3552	
25.	46.300	31.0352	30.4071	10.2215	
30.	55.560	35.0799	34.4948	21.2548	
40.	74.080	36.0679	35.7961	34.1508	
50.	92.600	32.8376	32.6266	37.4436	
60.	111.120	29.4805	29.2604	37.3449	
75.	138.900	25.2107	24.9394	35.4033	
90.	166.680	21.9817	21.6405	33.0628	
120.	222.240	17.7000	17.1812	28.0628	
180.	333.360	13.3470	12.4114	21.4082	
240.	444.480	10.9123	9.5324	17.4889	
360.	666.720	8.6205	6.1845	15.2893	
480.	888.960	7.9491	4.2965	15.4385	
600.	1111.200	7.6724	3.1780	14.7235	
720.	1333.440	5.0044	1.6352	13.5201	
WIND,HOUR		20	13		
1.	1.852	7.7009	6.5613	-2.0170	**Interpolation between Snapshots 7 & 8**
2.	3.704	11.4624	10.8461	-1.3424	
3.	5.556	14.6585	14.2437	-0.4667	
4.	7.408	17.3708	17.0409	0.1374	
5.	9.260	19.5312	19.2268	0.5209	
6.	11.112	21.1956	20.8754	0.9853	
7.	12.964	22.4706	22.1060	1.7251	
8.	14.816	23.3862	22.9570	2.6868	
9.	16.668	23.9666	23.4606	3.6873	
10.	18.520	24.2226	23.6335	4.4648	
15.	27.780	24.8182	23.9490	1.5678	
20.	37.040	23.1526	27.4695	0.8347	
25.	46.300	33.2867	32.4993	10.3299	
30.	55.560	37.8870	37.1112	21.6899	
40.	74.080	40.1685	39.6787	37.0295	
50.	92.600	37.2299	37.0326	41.6416	
60.	111.120	33.6495	33.4597	42.3094	
75.	138.900	23.6322	28.4091	40.7412	
90.	166.680	24.6445	24.3656	38.3392	
120.	222.240	19.1697	18.7279	32.5782	
180.	333.360	13.6240	12.7291	23.5062	
240.	444.480	10.6611	9.2116	17.6683	
360.	666.720	8.2944	5.3560	14.5539	
480.	888.960	7.7899	3.4564	14.7954	
600.	1111.200	7.5948	2.4277	14.0900	
720.	1333.440	4.9736	1.1949	12.8509	

Figure C14. (Sheet 7 of 12)

Radius (n.m.)	Radius (km)	--- Wind Speed --- Scalar Avg. (m/sec)	Vector Avg. (m/sec)	Inflow Angle, (+ = in, - = out) (deg)	
WIND,HOUR		20	14		
1.	1.852	5.7881	1.0245	-54.9114	
2.	3.704	6.4541	3.9720	-24.5178	Snapshot 8
3.	5.556	9.4686	8.6090	-11.9362	
4.	7.408	13.4829	13.0106	-6.3941	
5.	9.260	15.7968	16.4585	-3.6516	
6.	11.112	19.4415	19.1273	-2.0103	
7.	12.964	21.5386	21.1914	-0.5934	
8.	14.816	23.1255	22.7110	0.8438	
9.	16.668	24.2274	23.7256	2.2342	
10.	18.520	24.8698	24.2708	3.3539	
15.	27.780	25.3710	25.4490	1.3220	
20.	37.040	30.1687	29.4218	1.2605	
25.	46.300	35.5447	34.5681	10.4418	
30.	55.560	40.6915	39.6964	22.0873	
40.	74.080	44.2657	43.9524	39.3821	
50.	92.600	41.6690	41.4767	44.9388	
60.	111.120	37.9086	37.7362	46.1393	
75.	138.900	32.1717	31.9795	44.8648	
90.	166.680	27.4255	27.1891	42.4840	
120.	222.240	20.7241	20.3404	36.3204	
180.	333.360	13.9054	13.0482	25.5059	
240.	444.480	10.4115	8.8880	17.8943	
360.	666.720	8.0717	4.5179	13.6535	
480.	888.960	7.6928	2.6034	13.7065	
600.	1111.200	7.5579	1.6662	12.8807	
720.	1333.440	6.9537	0.7413	11.2853	
WIND,HOUR		20	15		
1.	1.852	5.2786	3.6952	-21.4673	Interpolation between Snapshots 8 & 9
2.	3.704	9.6598	8.8585	-8.8558	
3.	5.556	13.9015	13.4537	-3.6465	
4.	7.408	17.2845	16.9501	-1.3335	
5.	9.260	19.9031	19.5926	-0.1562	
6.	11.112	21.8548	21.5198	0.7374	
7.	12.964	23.2916	22.9027	1.7017	
8.	14.816	24.2837	23.8207	2.7128	
9.	16.668	24.8923	24.3430	3.6006	
10.	18.520	25.1624	24.5209	4.1324	
15.	27.780	25.3268	25.4590	0.4130	
20.	37.040	30.7382	30.0349	2.6953	
25.	46.300	35.3498	35.5371	14.4592	
30.	55.560	40.5023	39.6200	25.8454	
40.	74.080	41.5230	41.2674	39.3602	
50.	92.600	37.9830	37.7975	43.0899	
60.	111.120	34.0207	33.8370	43.3371	
75.	138.900	28.6710	28.4499	41.4519	
90.	166.680	24.4793	24.1978	38.8288	
120.	222.240	18.7628	18.3017	32.6069	
180.	333.360	13.0273	12.0419	22.6556	
240.	444.480	10.0310	8.3815	16.5407	
360.	666.720	8.0627	4.5075	13.6395	
480.	888.960	7.6978	2.7350	13.7344	
600.	1111.200	7.5589	1.8231	12.9673	
720.	1333.440	6.9534	0.8437	11.6417	

Figure C14. (Sheet 8 of 12)

Radius (n.m.)	Radius (km)	--- Wind Speed --- Scalar Avg. (m/sec)	Vector Avg. (m/sec)	Inflow Angle, (+ = in, - = out) (deg)	
WIND,HOUR		20	16		
1.	1.852	7.5921	6.3574	-15.8577	
2.	3.704	13.8447	13.4131	-2.9746	**Snapshot 9**
3.	5.556	18.2339	17.9469	0.7354	
4.	7.408	21.1606	20.8925	1.7934	
5.	9.260	23.0540	22.7538	2.2868	
6.	11.112	24.2866	23.9272	2.8904	
7.	12.964	25.0617	24.6285	3.6555	
8.	14.816	25.4596	24.9436	4.4044	
9.	16.668	25.5713	24.9689	4.8958	
10.	18.520	25.4633	24.7739	4.8956	
15.	27.780	25.2953	25.4727	-0.4949	
20.	37.040	31.3771	30.6556	4.0804	
25.	46.300	37.3395	36.6335	18.2633	
30.	55.560	40.5397	40.0771	29.5947	
40.	74.080	38.7619	38.5545	39.3625	
50.	92.600	34.2823	34.0974	40.8550	
60.	111.120	30.1596	29.9541	39.8027	
75.	138.900	25.2403	24.9730	37.0471	
90.	166.680	21.6228	21.2727	34.0914	
120.	222.240	15.8975	16.3266	27.8725	
180.	333.360	12.1601	11.0181	19.3734	
240.	444.480	9.6775	7.8774	15.0447	
360.	666.720	8.0558	4.4971	13.6266	
480.	888.960	7.7047	2.8664	13.7609	
600.	1111.200	7.5622	1.9796	13.0339	
720.	1333.440	4.9545	0.9461	11.9152	
WIND,HOUR		20	17		
1.	1.852	5.1944	3.3138	-17.8760	**Interpolation between Snapshots 9 & 10**
2.	3.704	8.2681	7.2138	-6.8815	
3.	5.556	10.7056	10.0051	-4.1496	
4.	7.408	12.7647	12.1956	-3.0712	
5.	9.260	14.7353	14.2314	-2.2659	
6.	11.112	15.6943	16.2217	-1.2967	
7.	12.964	18.5415	18.0779	-0.2965	
8.	14.816	20.2149	19.7445	0.5915	
9.	16.668	21.6830	21.1908	1.2304	
10.	18.520	22.9397	22.4105	1.6022	
15.	27.780	27.8821	27.2105	1.1748	
20.	37.040	32.6080	32.0467	5.5860	
25.	46.300	35.3954	35.8652	14.8451	
30.	55.560	38.1757	37.7211	22.5590	
40.	74.080	37.0872	36.7704	30.7857	
50.	92.600	34.6084	34.3532	34.4098	
60.	111.120	32.1141	31.8807	36.0672	
75.	138.900	28.4567	28.2119	36.6382	
90.	166.680	25.2441	24.9620	35.9514	
120.	222.240	20.3278	19.9233	32.5304	
180.	333.360	14.6386	13.8605	25.1756	
240.	444.480	11.3865	10.1154	19.1383	
360.	666.720	8.4428	5.7836	14.1522	
480.	888.960	7.8172	3.5385	13.6463	
600.	1111.200	7.5980	2.3437	12.9271	
720.	1333.440	4.9691	1.0852	11.8318	

Figure C14. (Sheet 9 of 12)

Radius (n.m.)	Radius (km)	--- Wind Speed --- Scalar Avg. (m/sec)	Vector Avg. (m/sec)	Inflow Angle, (+ = in, - = out) (deg)	
WIND,HOUR		20	18		
1.	1.852	5.8467	0.1474	-88.3850	
2.	3.704	5.8913	0.3323	-80.3511	Snapshot 10
3.	5.556	5.9854	0.7624	-51.3616	
4.	7.408	5.1382	2.1004	-27.6604	
5.	9.260	5.7706	4.7446	-17.3690	
6.	11.112	9.0271	8.0799	-12.3260	
7.	12.964	12.0708	11.4742	-8.8906	
8.	14.816	15.0533	14.6107	-6.1866	
9.	16.668	17.8664	17.4786	-4.1897	
10.	18.520	20.4882	20.1007	-2.5294	
15.	27.780	29.5051	28.9509	2.6555	
20.	37.040	33.9718	33.4147	6.9510	
25.	46.300	35.6832	35.1937	11.2949	
30.	55.560	35.3991	35.8866	14.7093	
40.	74.080	35.2753	35.7456	21.5719	
50.	92.600	35.3740	34.9881	28.1950	
60.	111.120	34.2038	33.9125	32.8383	
75.	138.900	31.6678	31.4230	36.3589	
90.	166.680	28.8703	28.6221	37.3360	
120.	222.240	23.8659	23.5513	35.6325	
180.	333.360	17.1794	16.6087	29.1446	
240.	444.480	13.2542	12.2959	22.2227	
360.	666.720	9.1195	7.0444	14.5881	
480.	888.960	7.9716	4.2027	13.5547	
600.	1111.200	7.6452	2.7066	12.8437	
720.	1333.440	4.9840	1.2224	11.7472	
WIND,HOUR		20	19		
1.	1.852	5.8873	0.1315	267.8173	Interpolation between Snapshots 10 & 11
2.	3.704	5.9185	0.2864	-85.9611	
3.	5.556	5.9876	0.5704	-62.3600	
4.	7.408	5.0828	1.4068	-35.5808	
5.	9.260	5.4022	3.4218	-21.5389	
6.	11.112	7.7488	6.4805	-15.1524	
7.	12.964	10.6217	9.8852	-11.4492	
8.	14.816	13.7639	13.2437	-8.3193	
9.	16.668	15.7812	16.3407	-5.9519	
10.	18.520	19.6647	19.2310	-4.1128	
15.	27.780	30.2064	29.6647	1.3036	
20.	37.040	35.6643	35.1813	7.1232	
25.	46.300	37.6751	37.1826	12.9720	
30.	55.560	38.4773	37.9349	17.8365	
40.	74.080	37.8872	37.4660	26.6277	
50.	92.600	35.1374	35.8437	32.4841	
60.	111.120	34.0912	33.8478	35.6165	
75.	138.900	30.5693	30.3335	37.1984	
90.	166.680	27.2103	26.9485	36.9100	
120.	222.240	21.8017	21.4339	33.6605	
180.	333.360	15.3121	14.5863	25.7770	
240.	444.480	11.6306	10.3863	18.7814	
360.	666.720	8.3756	5.5758	13.0014	
480.	888.960	7.7792	3.2149	12.4173	
600.	1111.200	7.5839	2.0212	11.7434	
720.	1333.440	4.9611	0.8834	10.6389	

Figure C14. (Sheet 10 of 12)

Radius (n.m.)	Radius (km)	--- Wind Speed --- Scalar Avg. (m/sec)	Vector Avg. (m/sec)	Inflow Angle, (+ = in, - = out) (deg)	
WIND,HOUR		20	20		
1.	1.852	5.9287	0.1162	262.9949	
2.	3.704	5.9470	0.2442	266.3879	Snapshot 11
3.	5.556	5.9963	0.4185	-82.6926	
4.	7.408	6.0763	0.7876	-57.0778	
5.	9.260	6.1921	2.0833	-30.7253	
6.	11.112	6.8094	4.8376	-19.6630	
7.	12.964	9.1999	8.2625	-14.5830	
8.	14.816	12.4422	11.8214	-10.8999	
9.	16.668	15.7084	15.2023	-7.9758	
10.	18.520	18.8605	18.3726	-5.8433	
15.	27.780	30.9314	30.3868	0.0276	
20.	37.040	37.4365	36.9167	7.2898	
25.	46.300	39.7792	39.1634	14.4881	
30.	55.560	40.6823	40.0401	20.6426	
40.	74.080	39.7404	39.3892	31.2106	
50.	92.600	37.0910	36.8561	36.5571	
60.	111.120	34.0673	33.8533	38.4093	
75.	138.900	29.4841	29.2478	38.1131	
90.	166.680	25.5521	25.2662	36.4341	
120.	222.240	19.7706	19.3250	31.2195	
180.	333.360	13.5125	12.5523	21.3094	
240.	444.480	10.1318	8.4430	14.2101	
360.	666.720	8.0124	4.0795	10.4747	
480.	888.960	7.6745	2.2099	10.1812	
600.	1111.200	7.5460	1.3164	9.3948	
720.	1333.440	6.9515	0.5429	6.0716	
WIND,HOUR		20	21		
1.	1.852	5.8757	0.1576	268.9495	Interpolation between Snapshots 11 & 12
2.	3.704	5.9111	0.3922	-77.2274	
3.	5.556	5.9792	1.0670	-45.1869	
4.	7.408	6.2267	2.7191	-27.0611	
5.	9.260	7.1538	5.5461	-17.8151	
6.	11.112	9.9381	9.1108	-12.9344	
7.	12.964	13.2739	12.7167	-9.3226	
8.	14.816	16.5174	16.0578	-6.5766	
9.	16.668	19.5786	19.1314	-4.5214	
10.	18.520	22.3568	21.8765	-2.8559	
15.	27.780	31.7253	31.1325	1.6857	
20.	37.040	36.4453	35.8979	7.4276	
25.	46.300	38.1408	37.5264	13.7821	
30.	55.560	38.9178	38.2712	19.6641	
40.	74.080	38.2284	37.8720	30.4967	
50.	92.600	35.6980	35.4598	35.9404	
60.	111.120	32.7401	32.5198	37.7223	
75.	138.900	28.2836	28.0357	37.3035	
90.	166.680	24.4976	24.1939	35.5394	
120.	222.240	18.9903	18.5127	30.2212	
180.	333.360	13.0686	12.0446	20.4456	
240.	444.480	9.6837	8.1095	13.8851	
360.	666.720	7.9783	3.9614	10.7447	
480.	888.960	7.6647	2.1807	10.4769	
600.	1111.200	7.5406	1.3178	9.6964	
720.	1333.440	6.9487	0.5516	8.3981	

Figure C14. (Sheet 11 of 12)

Radius (n.m.)	Radius (km)	--- Wind Speed --- Scalar Avg. (m/sec)	Vector Avg. (m/sec)	Inflow Angle, (+ = in, - = out) (deg)
WIND,HOUR		20	22	
1.	1.852	5.8255	0.2000	-87.6107
2.	3.704	5.8812	0.5546	-70.1721
3.	5.556	5.0218	1.8204	-37.1198
4.	7.408	5.7394	4.6981	-21.8820
5.	9.260	9.6611	8.8197	-14.1624
6.	11.112	13.5649	13.0636	-9.2704
7.	12.964	17.2198	16.8280	-6.1336
8.	14.816	20.5720	20.1906	-3.9692
9.	16.668	23.4862	23.0649	-2.2587
10.	18.520	25.8745	25.3865	-0.7408
15.	27.780	32.5430	31.8957	3.2647
20.	37.040	35.4582	34.8746	7.5786
25.	46.300	35.5038	35.8823	13.0161
30.	55.560	37.1546	36.4978	18.5939
40.	74.080	35.7130	36.3500	29.7262
50.	92.600	34.3014	34.0590	35.2759
60.	111.120	31.4108	31.1831	36.9782
75.	138.900	27.0841	26.8226	36.4202
90.	166.680	23.4467	23.1226	34.5579
120.	222.240	18.2176	17.7032	29.1176
180.	333.360	12.6231	11.5294	19.5335
240.	444.480	9.6441	7.7750	13.5450
360.	666.720	7.9456	3.8433	11.0326
480.	888.960	7.6550	2.1516	10.7810
600.	1111.200	7.5351	1.3193	9.9973
720.	1333.440	6.9459	0.5603	8.7143

FORTRAN STOP

Snapshot 12

Figure C14. (Sheet 12 of 12)

Appendix D Sample Application of Upgraded CE Model to Simulation of 36-Hr Period of Hurricane Gilbert in the Gulf of Mexico

This appendix provides information related to a 36-hr simulation of Hurricane Gilbert in the Gulf of Mexico. The simulation was performed by OWI as an additional test with the upgraded CE model. The simulation time period begins 1200 UTC (Universal Time Coordinate, formerly known as Greenwich Mean Time) 15 September 1988. The four snapshots used in the simulation all took advantage of the double exponential form for pressure profile specification. Input file information on the snapshots and storm track specification is provided in this appendix.

The appendix also includes plots of Hurricane Gilbert wind fields. Model wind fields at 19-m elevation are given at 6-hr intervals throughout the simulation period. Wind speed and direction is represented with the conventional weather map "wind barb" notation. The shaft of each wind arrow indicates the direction and the barbs or "feathers" indicate wind speed. A half-barb denotes 5 knots, full barb denotes 10 knots, and solid flag denotes 50 knots.

```
$ type 05gilbert88.dat
 $name1  Kzm = 8809, Kdh = 151100, Kmin = 60, inside=1,
   nstres=17227, Kstres = 0, Kwind = 19, nwind = 4661, hh=500.  $end
   ame2  eyelat=22, eypres=951, pfar=1012, radius=11.88,46.85, holl=.56,2.52,
  dp1=45.07, direc=290, speed=11, sqw=7, ani=120  $end
 $name2  eyelat=23, eypres=949, pfar=1010, radius=11.88,43.53, holl=.75,2.52,
  dp1=40.67, sqw=8  $end
 $name2  eyelat=24, eypres=953, pfar=1010, radius=27,64.21, holl=1.33,2.52,
  dp1=46.62, sqw=9  $end
 $name2  eyelat=24, eypres=954, pfar=1009, radius=21.6,60.61, holl=1.19,2.52,
  dp1=44.98  $end
 $name2  eyelat = 999  $end
   0  21  54 -91  42   1
   1  21  54 -91  42   1
   7  22   5 -92  48
  13  22  30 -93  48   2
  19  22  54 -94  48
  25  23  42 -95  54
  31  23  54 -97   0   3
  37  24  24 -98  12   4
 999
 $what  Kstep2 = 37  $end
```

Figure D1. Snapshot and storm track specification, Hurricane Gilbert

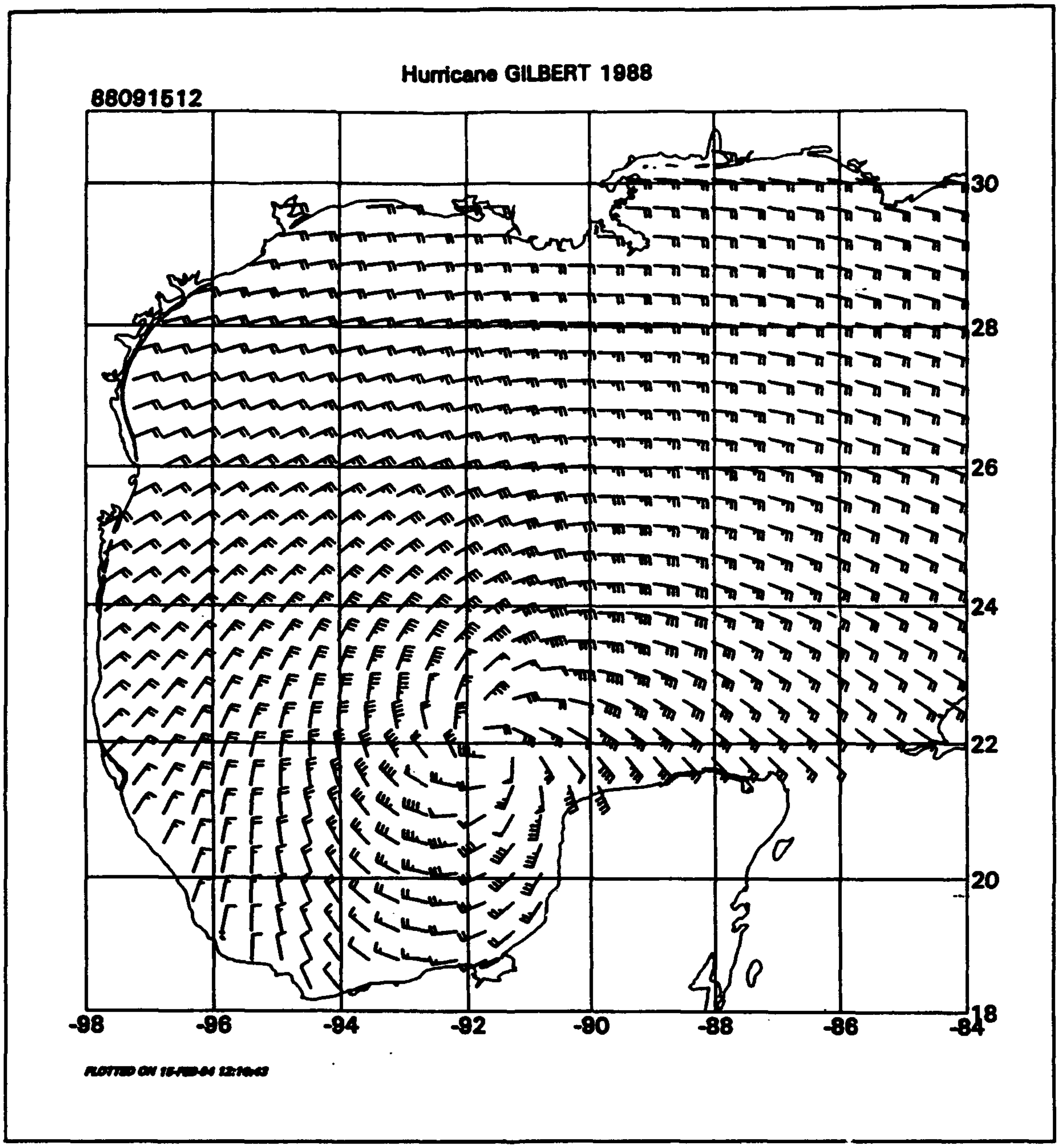

Figure D2. Modelled surface wind field in Hurricane Gilbert (Sheet 1 of 7)

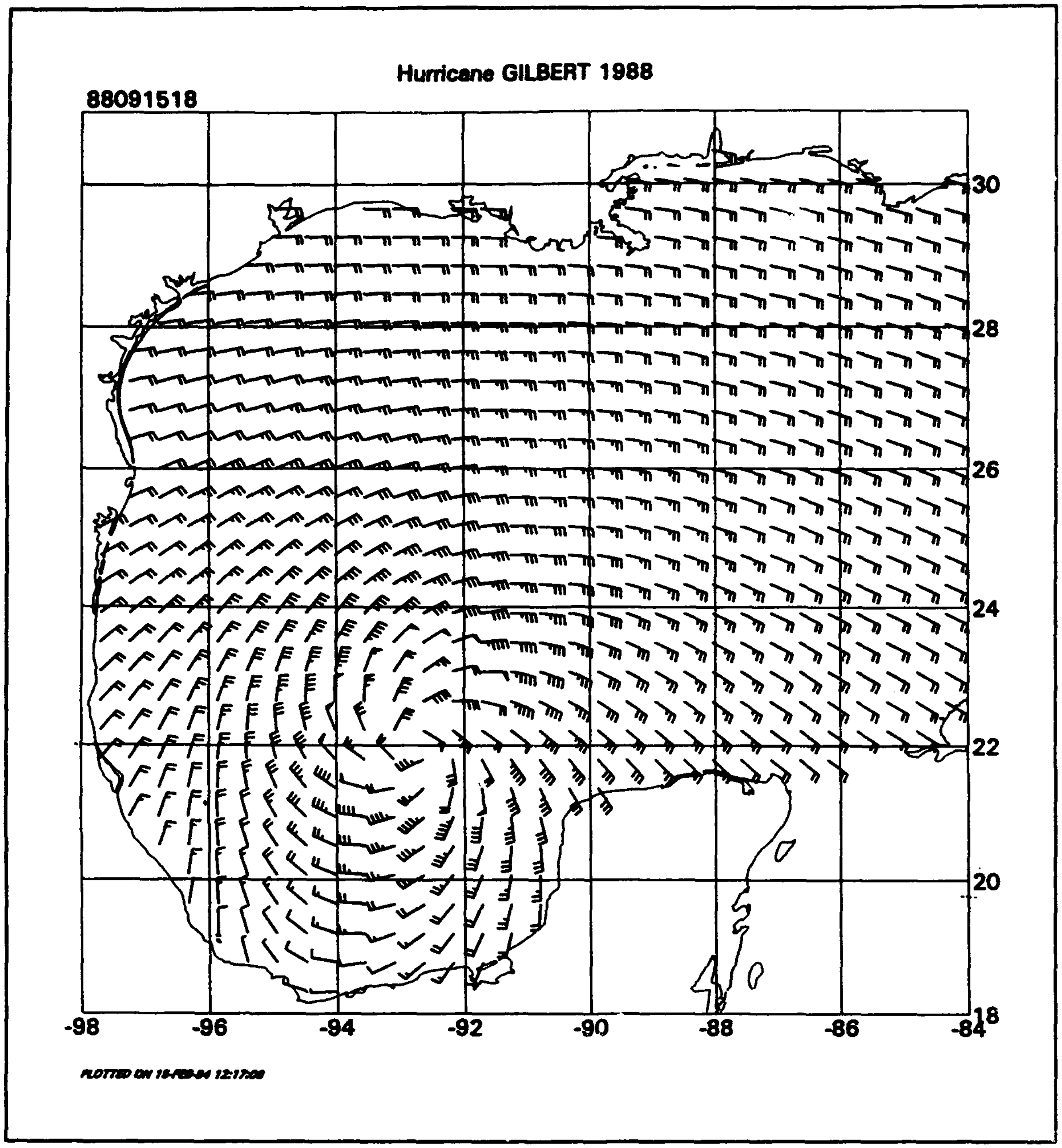

Figure D2. (Sheet 2 of 7)

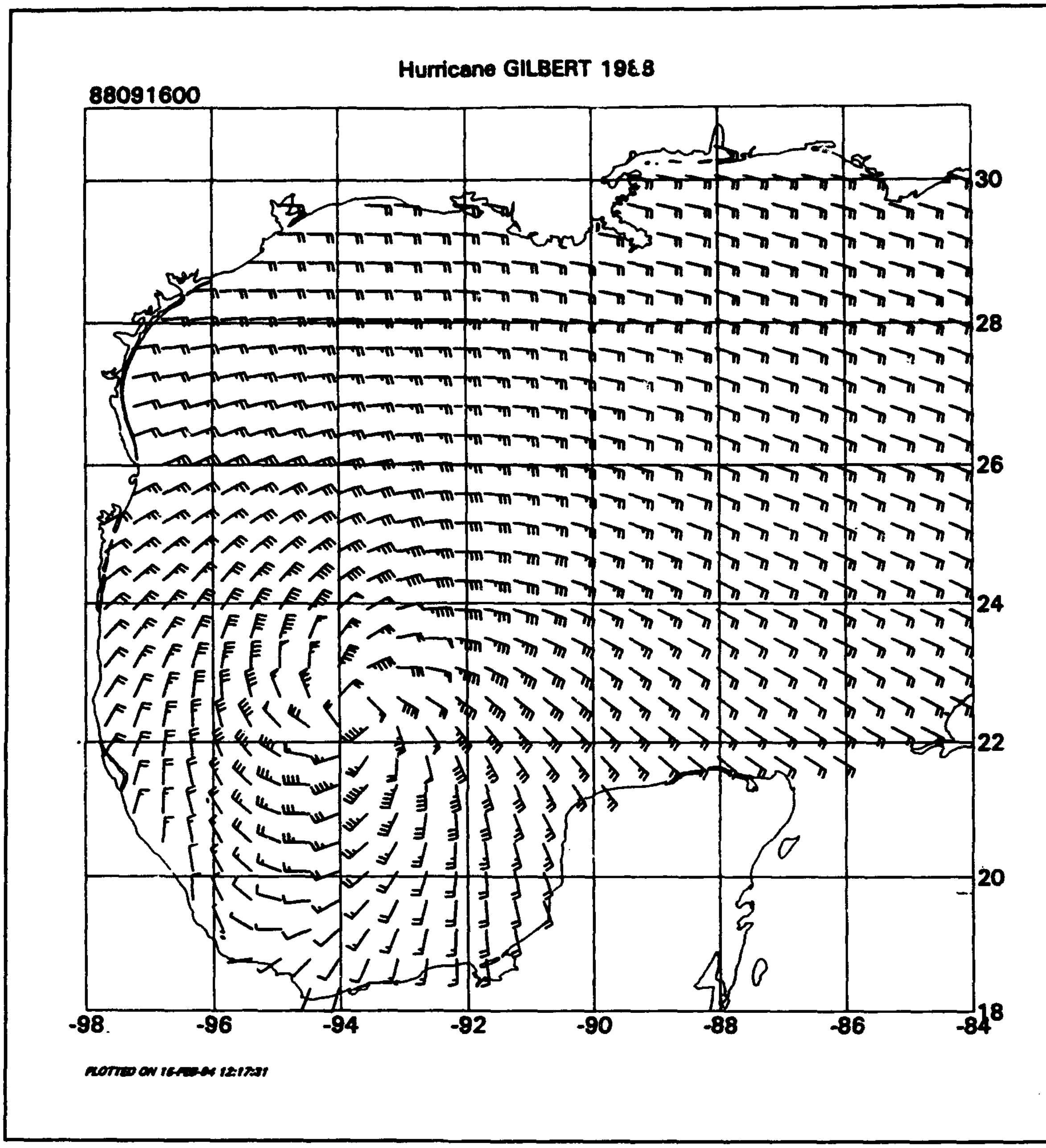

Figure D2. (Sheet 3 of 7)

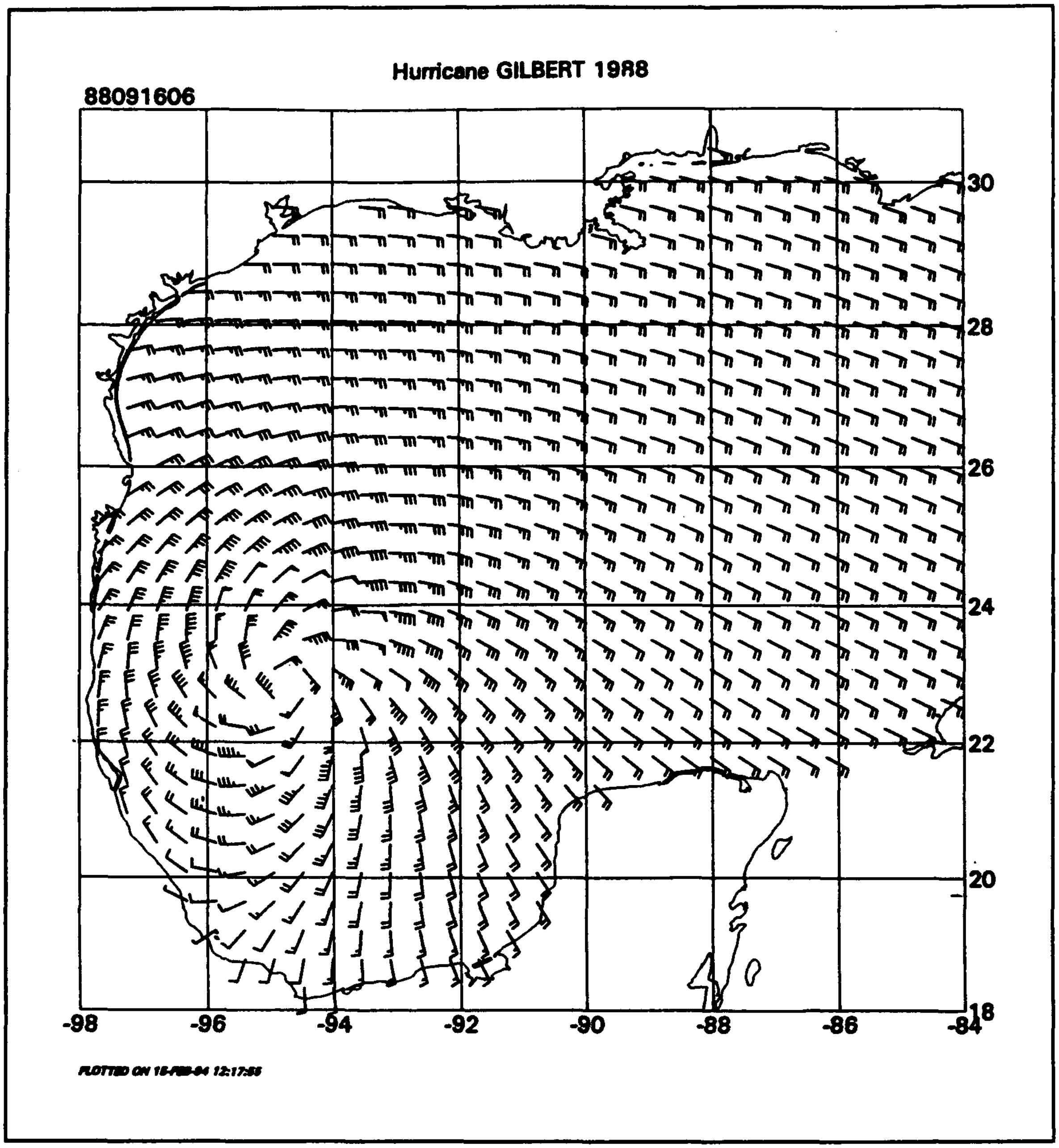

Figure D2. (Sheet 4 of 7)

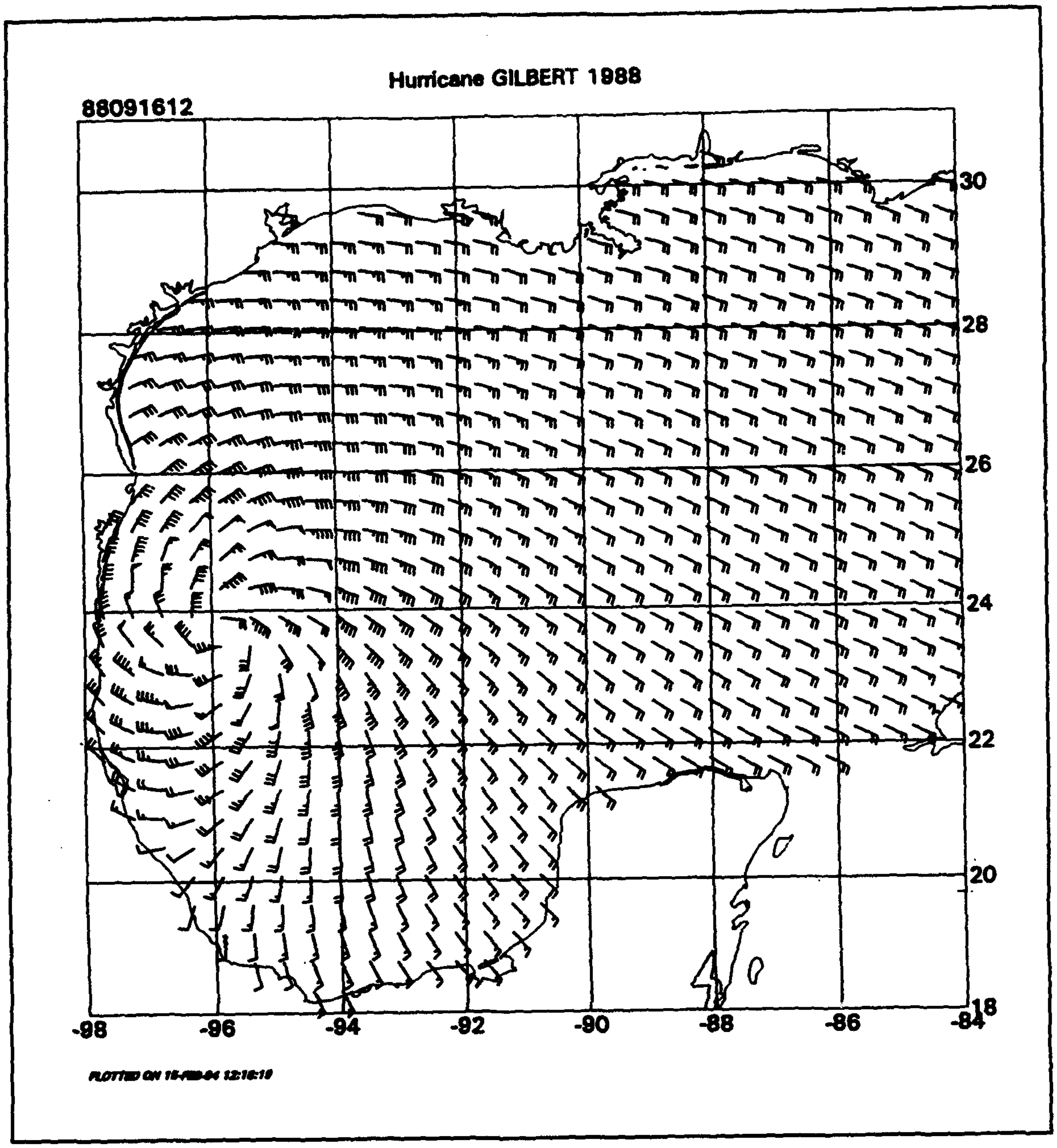

Figure D2. (Sheet 5 of 7)

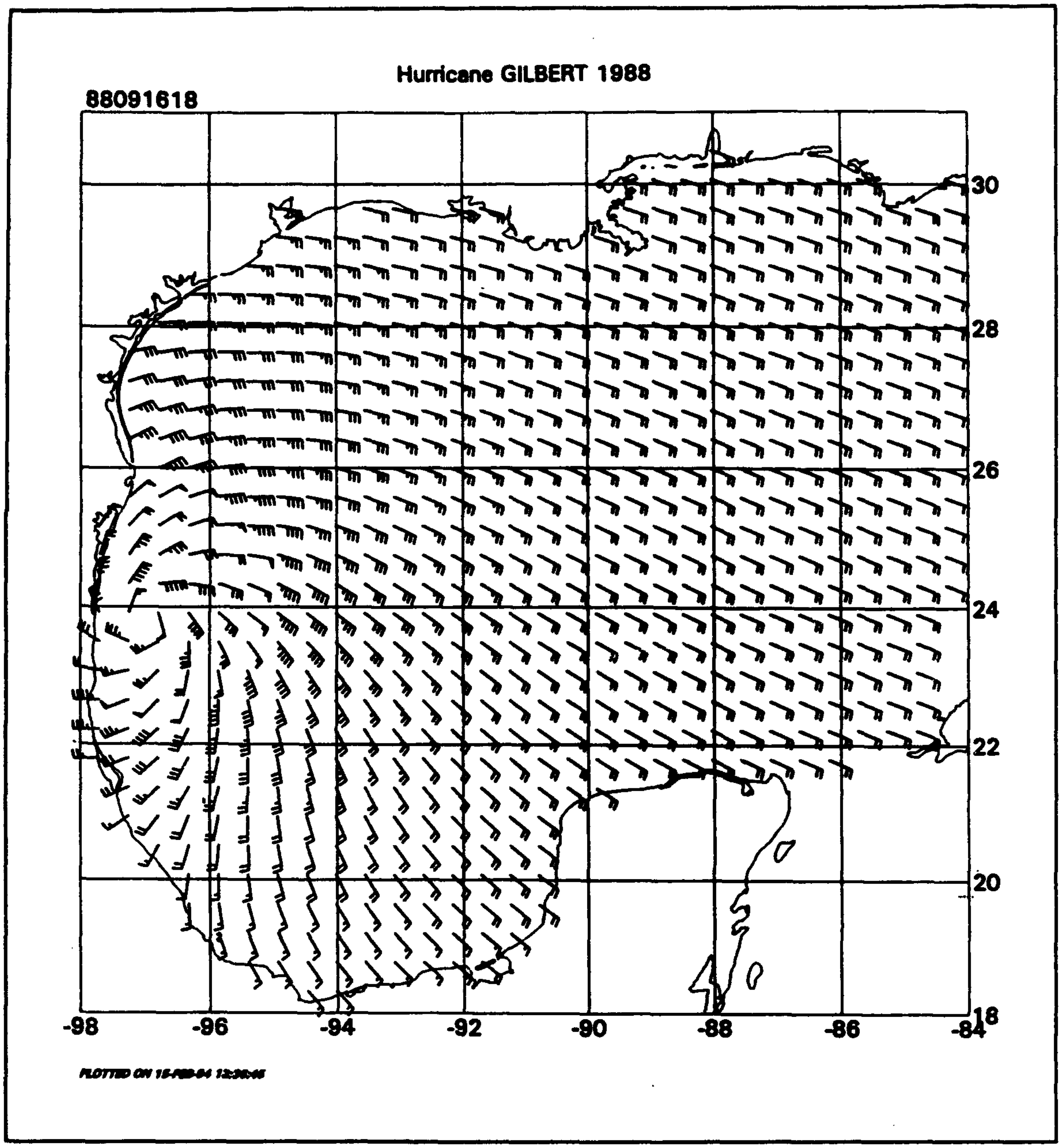

Figure D2. (Sheet 6 of 7)

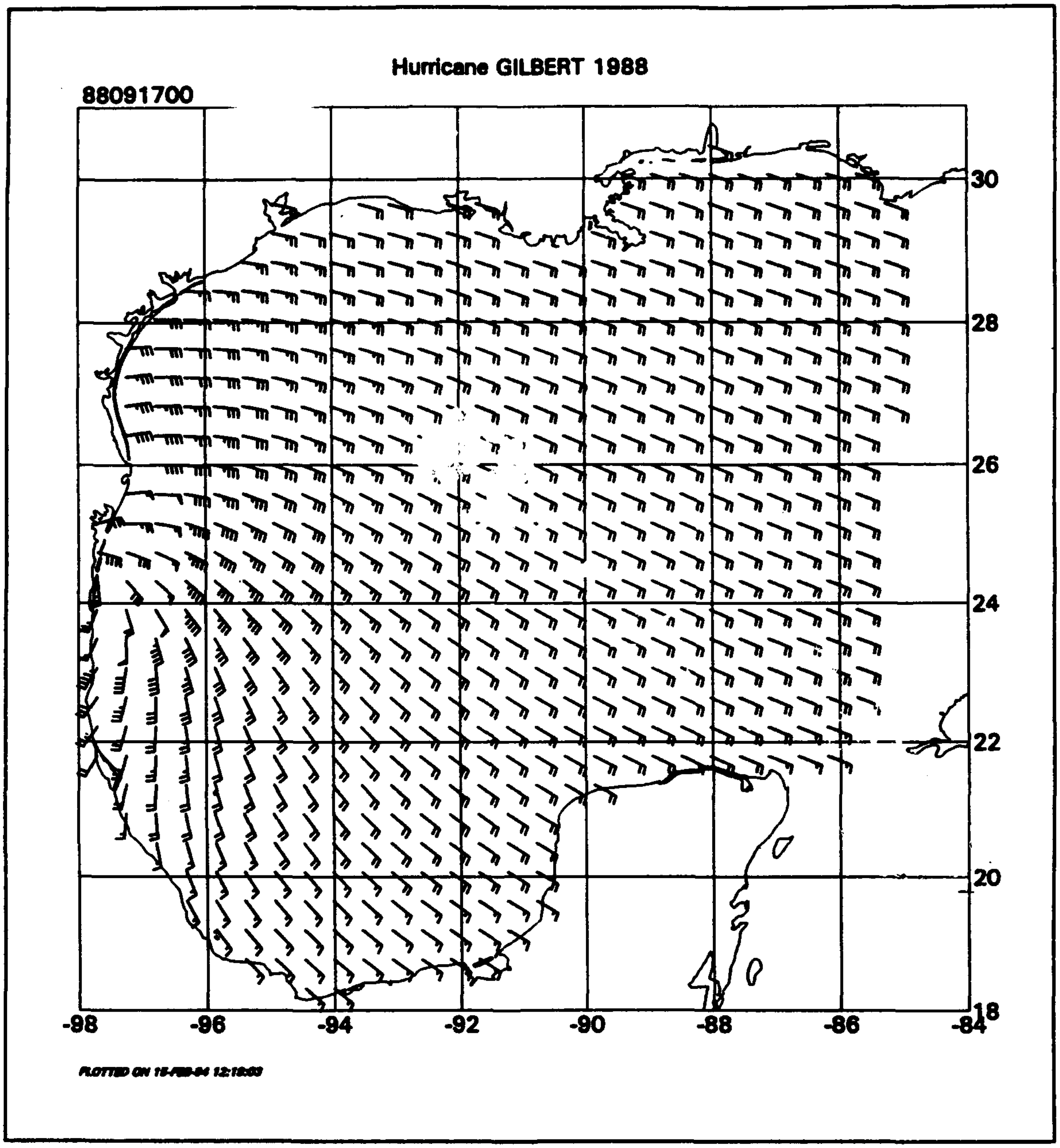

Figure D2. (Sheet 7 of 7)

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13. ABSTRACT *(Maximum 200 words)*

The U.S. Army Corps of Engineers (CE) tropical cyclone surface wind field model has been a very useful tool in ocean response modeling for more than a decade. Recently, its limitations were assessed in light of present knowledge and technology. Model limitations were identified and evaluated in terms of their perceived importance to ocean response modeling and the level of effort required to develop improved solutions. The limitations are summarized in this report.

Two aspects of the CE model were targeted for improvement. This report describes the improvements developed for the upgraded model. First, the model was upgraded to include more computationally intensive options which give improved resolution and areal coverage. Up to seven nested grids are now available, compared to only five nests in the standard model. In a typical application, this upgrade can be used to achieve 2-km resolution around the eye (as compared to 5-km resolution often used in the standard model) and an expanded total coverage area.

The second upgrade allows a more general specification of the axisymmetric pressure profile. This upgrade can be used to create wind fields with maxima at two different radii or with a broad maximum extending over a range of radii. It also provides more flexibility in fitting the shape of single peaked wind profiles.

(Continued)

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The upgraded model is demonstrated with historical hurricanes. The five-nest and seven-nest models are applied to Hurricane Camille. The fully upgraded model, with seven nests and general pressure specification, is applied to Hurricane Gilbert. This hurricane was chosen because it is well-documented by Black and Willoughby (1992) and it evolved into some nontraditional storm structures. The upgraded model was more effective than the standard CE model in simulating the storm.